

Model E-AR-400



**SURGE NEEDLE SET**  
ROTATE UNTIL NEEDLE  
IS IN OR "ARC"

**SURGE DISCHARGER**

PRESS DOWN TO RELEASE SURGE NEEDLE



**MATHISON ELECTROPSYCHOMETER**

Model E-AR-400  
TONE NEEDLE RESET

**OSCILLATOR CUT-OFF**  
SET CLOSE TO SIGNAL POINT

**AUDIO VOLUME**

**AUDIO SENSITIVITY**

HIGH LOW

**AUDIO SENSITIVITY**

**TONE SCALE**

**SELECTOR**

**SURGE**

**AUDIO**

**ATED AUDIO**

ENERGY INPUT FROM PATIENT  
**SURGE METER SENSITIVITY**  
SURGE NEEDLE DAMPING

Manufactured under license by  
**ARCON MFG. CO.**  
1214 WEST 20TH STREET  
LOS ANGELES 7, CALIFORNIA, U.S.A.



NEVER REWIND TAP  
RECORD WITH TAP  
A 1000 RPM ALARM



1000 RPM SWEEP

NEVER REWIND TAP



BATTERY ELECTROLYTE

Model E-A-R-400  
Tape Reading Meter



RECORDING



1000 RPM



RECORDING

SWEEP



LOW



RECORDING



LOW



RECORDING

LOW

RECORDING

LOW

Model E-AR-400 ElectropsychometerOPERATING INSTRUCTIONS

- 1: Handle all knobs GENTLY! DO NOT TWIST ANY KNOB HARD against stopping point, or instrument may be seriously damaged.
- 2: AC on-off switch is on RED KNOB, on lower right hand corner of panel. When starting, first turn on only enough to light up meter panels. Set red knob at about "1." until all following instructions have been observed.
- 3: FUNCTION SELECTOR SWITCH. This, the master switch, is on large lower CENTRAL knob. Carefully observe lettering on panel above this knob. This control has THREE positions only. White bar on skirt of knob may be placed straight up, or one step to right or one step to left.

The step to right, lettered SURGE METER, on the panel switches in both the surge meter and the tone meter.

To use the audio-signalling section of the instrument, turn function selector knob so that white bar on skirt of knob points STRAIGHT UP toward the lettering "AUDIO."

To use "inverted audio," turn knob another step clockwise so that white bar on skirt of knob is at "INVERTED AUDIO" position. When master switch is in this position and the instrument is properly adjusted, there will occur a CONTINUOUS audio signal, except when search probe contacts a relatively unfavorable area, whereupon the signal drops out or ceases. This mode of using the instrument is not much used, so far, but it is available.

- 4: TONE SCALE SELECTOR SWITCH: This is large lower left-hand control, and is so marked. The letters "D" "C" "B" etc at the selector switch corresponds to the same letters "D" "C" "B" etc, on the scales of the TONE meter up on the sloping part of front panel.

When first using instrument at a new location, it is necessary to calibrate this meter. To calibrate;

Rotate TONE SELECTOR control so that white bar on knob skirt is at "C" position. Press pushbutton which is just above the tone selector control. While holding the button down, rotate the small black knob next to the push-button, which is marked TONE NEEDLE RESET, turning until the needle of the tone meter reads at about 2.3 on the "C" scale of the meter. This calibration must be made with NO ONE HOLDING THE HAND ELECTRODE.



- 5: AFTER calibrating as instructed in preceding paragraph, the therapist may have patient take up the hand electrode. Most patients will be found to read on the "C" scale, that is with TONE SELECTOR SWITCH at the "C" position. If a patient does not; that is, if needle remains at end of scale, at the right or left, rotate the tone scale selector knob to the "B" or "D" position, as required. For interpretation of tone meter readings please refer to the tone scale chart herewith, and to the manual ELECTROPSYCHOMETER

-- TO USE SURGE METER --

- 6: After having proceeded as above, turn up lower right-hand RED knob marked OUTPUT SENSITIVITY to about "3" Push down for several seconds on pushbutton up on sloping panel between meters, marked SURGE DISCHARGER. Then bring needle of surge meter into the black arc area of the meter scale by slowly rotating the chromed-end knob marked SURGE NEEDLE SET. This surge-needle resetting or rezeroing control is just below the "M" emblem up on sloping panel. Turn slowly.
- 7: Use the SURGE DISCHARGER pushbutton frequently while getting patient settled on instrument. Once a consultation is well started it may not be necessary to make much use of the surge discharger button, but it must be pressed several times, usually when first starting. This brings the surge needle back into black arc promptly after mechanical surges caused by handling the hand electrode consciously, or when changing from one hand to the other, or when moving about on the couch, and the like.
- 8: IMPORTANT: Have patient squeeze hard and relax on electrode eight or ten times. This reduces conscious interest in the electrode. See added instructions herein Page 4
- 9: DO NOT ALLOW PATIENT TO CLASP BOTH HANDS OVER ELECTRODE. Do not let patient tap on electrode with thumb or fingers.
- 10: Normal working levels of surge meter controls: OUTPUT SENSITIVITY (Red Knob) between 2 and 4. INPUT SENSITIVITY (small black knob directly over red knob) set at about "5" THIS CONTROL IS VERY SELDOM USED; generally left midway at about "5." May be advanced only if a patient will not respond with lower RED KNOB turned full on at 11. This is extremely rare; may indicate a condition of extreme armoring or barrier-development; or might indicate a physical condition of multiple sclerosis.

-- TO USE AUDIO REGISTRATION CIRCUIT --

- 11: Insert input terminal of red probe cord into chassis on rear of instrument.

- 12: Turn function selector switch (Large lower central knob) so that white bar on skirt of knob points STRAIGHT UP toward the word "AUDIO" . . . on panel directly above this control.
- 13: Note that there are two chromed-end knobs immediately above the central function-selector knob. One of these is marked "OSCILLATOR CUT-OFF" and the other is marked "AUDIO VOLUME."

Rotate the knob marked OSCILLATOR CUT-OFF counterclockwise until an audio signal is heard. Then turn this knob back CLOCKWISE, until the audio signal barely ceases. This is the correct and ONLY operating point for this control---on the CLOCKWISE "fringe" of the signal---that is, slightly clockwise, just off the point of signal.

Adjust the adjacent chromed-end knob marked "VOLUME CONTROL" to desired degree of loudness of signal. Degree of loudness used has no relation to sensitivity of operation.

- 14: Have patient take up hand electrode. Apply search probe ---to bare skin only. Adjust to best response effect by rotating large lower right hand knob marked AUDIO SENSITIVITY.

If no signal can be found, with AUDIO SENSITIVITY control turned fully on to "11" then transfer the small snap switch just above the AUDIO SENSITIVITY KNOB from "LOW" to "HIGH." This sometimes causes a signal to start, whether probe is in contact with patient or not. This is beyond working range, and so the AUDIO SENSITIVITY control must now be turned back counter-clockwise.

- 15: THE BASIC RULE IS: If search probe signals too freely, turn AUDIO SENSITIVITY control back toward a lower setting, and or move snap switch above AUDIO SENSITIVITY control back from "HIGH" to "LOW." On the other hand, if no signal can be found, move AUDIO SENSITIVITY control clockwise, move snap switch to "HIGH." Adjust so that only major areas are picked up and minor areas are dropped out.

- 16: Improvement in an area cannot usually be indicated by a drop out of signal immediately after an osteopathic or chiropractic type of adjustment---that is not for at least twenty minutes or preferably at the NEXT appointment, since associated muscular inflammation does not immediately subside even though the treatment applied is to be successful.

IMPORTANT! If chromed-end knob marked "OSCILLATOR CUT-OFF" is turned to left, counter-clockwise, beyond signalling point, instrument will not operate at all. If this knob is turned too far clockwise, that is too far "away from the signal," instrument will generate a bad, spluttery signal and will not operate properly.

KEEP LOWER RIGHT HAND RED KNOB TURNED DOWN AT ABOUT "1" WHEN ADJUSTING ANY OTHER CONTROLS OR AT ALL TIMES WHEN NOT ACTUALLY WORKING ON PATIENT. THIS PROTECTS THE SENSITIVE SURGE METER.



Condensed Report of Results of  
ELECTROPSYCHOMETRIC ANALYSIS by VOLNEY G. MATHISON  
of Five Cases at Doctors' Class  
Hotel Biltmore, Atlanta, Georgia, December 29 to 31, 1954

1. An attractive girl released from the stranglehold of a father, who after losing his wife, had, in a psychic sense at least, proceeded to make a virtual wife of his daughter, with the consequence that it was impossible for her to live a happy, normal life. The case resolved with apparently complete insight or awareness, at least for her if not for her father. (Time: father 2 hours; daughter 20 minutes.)

2. A pleasant and likable doctor brought out of a mild degree of psychosis generated over a long period as a consequence of his very short physical stature. Had been living in a state of severe psychic stress in his endeavors to maintain a "big" but wholly false front. This struggle included membership in costly country clubs where he had lost thousands of dollars on golf wagers in vain efforts to pose as a "big shot". He even eventually lost his home as a result of this type of wagering. This man was living under a powerful compulsion to make a big impression on everyone he met; yet all this was unnecessary and self-defeating as he was in reality, when his normal relaxed self, an extremely likable chap. Electropsychometric analysis shows a long series of psychic traumas, all somewhat minor but cumulative. Apparently the case gained rapidly a high degree of insight in analysis; declared he was junking his country club membership and asked me to order for him Korzybski's "Science and Sanity", which he has agreed to read through three times, at his leisure, and then make his impressive front by being able to discourse on the subject matter of that book. (2 hours.)

3. A very dramatic case. A wealthy and successful doctor, one of the largest practitioners of his type in America, married to a lovely woman; has three children, a beautiful home, but in the midst of a tragically inexplicable crisis; his major problem: a tormenting fear that his wife did not sufficiently love him; he seemed to demand that she devote every waking minute to him; became furious, and disturbed at every seeming failure on her part to do this.

The basic cause, rapidly disclosed in Electropsychometric analysis: The doctor's mother is an extremely positive, domineering, and strong-willed creature who had desperately opposed and fought her son's marriage; she wanted the boy wholly for herself. Defeated by an equally strong-willed son, she lives in a state of unrelenting hatred for the girl, and finally, it would seem, at least, that through psychic factors she established a personality-transference-like situation whereby she caused her son to act toward his wife AS SHE, THE MOTHER, WOULD LIKE TO ACT, thereby causing him to inflict intolerable mental cruelties upon a wholly lovable and lovely girl. It seemed that adequate insight was gained through the analysis; at any rate, a drastic alteration took place in the patient's demeanor and his wife later reported: "It's magical--he acts like an entirely different person. He's just as he used to be when we were first married. It's like a second honeymoon!" (Time: husband 2 hours; wife 3 hours.)

4. This case, from the standpoint of results of analysis, was a failure. The patient was formerly a top-flight research engineer, champion motor car racer, and a very high-drive and wealthy entrepreneur, now suffering from partial paralysis of the legs and violent indigestion; all the symptoms being judged, on the basis of the most extensive previous medical examinations, as being 100 per cent psychogenic. My personal evaluation of the case is that the patient's "subconscious mind" (whatever that may be) is desperately preventing him from further activity. No major improvement immediately observed as a result of analysis. This engineer, an intimate friend of the Wright Brothers, inventor of the airplane, did, however, transmit to me certain technical-research data that I consider invaluable in relation to my own work. Hence the time was well spent, even though the session did not seem to aid the patient as far as conscious awareness is concerned. My main "communication channel" seemed to be limited to contact with subconscious areas.

## MATHISON ELECTROPSYCHOMETERS

From manual "ELECTROPSYCHOMETRY"

Addenda Fourth Edition 2



Condensed Report of Results of  
ELECTROPSYCHOMETRIC ANALYSIS by VOLNEY G. MATHISON  
of Five Cases at Doctors' Class  
Hotel Biltmore, Atlanta, Georgia, December 29 to 31, 1954

5. The "Big" case at Atlanta. Electropsychometrically monitored analysis and resolution of a syndrome based on a major psychic trauma. Accomplished in two hours by Volney G. Mathison on a dual projection type of Electropsychometric installation before 150 attending doctors.

A young man suffering from a multiplicity of distressing symptoms. The worst and major one, however, was a recurrent sensation of being unable to breathe, a severe I-am-being-smothered-by-someone phobia.

This case, on being put on the Electropsychometer for analysis before the class, promptly and easily went into a considerable degree of hypnotic trance, with excellent and vivid recalls of past traumatic events. In less than ten minutes, the basic nature of the major trauma (the smother phobia) had been pinpointed on the SURGE meter. Or, rather, a series of four basically similar and related psychic traumas were revealed by the meter surges. The first one was at twelve years of age, involving surgery and the use of ether (an appendectomy). The second one was at nine years of age, also involving minor surgery and ether (adenoids scraped). The third one was at five years of age, again involving surgery and ether. (Tonsillectomy).

The patient was asked if there were any earlier similar events in his case. He replied that he was unable to recall any, but both the SURGE and TONE meters registered further drops on the projection screen. In fact, during the whole preliminary period of the analysis, the TONE meter kept going to lower readings, indicating that the Freudian principle of getting a recall up into conscious awareness of the EARLIEST related psychic trauma had not yet been accomplished.

The patient was therefore "counted down" (See "TECHNIQUES" in the manual "ELECTROPSYCHOMETRY") through the age of five, four, three, two, one year. The trance state seemed to deepen and at "birth", the ELECTROPSYCHOMETRIC TONE METER DROPPED TO A READING OF ABOUT 0.3! For some time, the patient could make no recalls--not even "fantasies involving the birth trauma. The procedure here, in brief, was to ask the patient to "make up images showing any kind of painful and dangerous situation in relation to your own birth. Let the situation be as fantastic and as unreal as you please. Just make up something, involving ETHER."

The patient at length "fantasied" the following sequence: Mother walking in a meadow; a black-and-white Holstein cow had just given birth to a calf and was "chewing on something like a string between her and the calf." Cow spies the woman, attacks; the mother screams wildly, leaps over a fence. Premature birth of infant begins somewhat later, perceptions of ether, of breathing, of being PUSHED BACK IN, of being violently seized by the head, of breathing again. Doctor's voice, persistent smell of ether, and other unidentifiable substances.

The climax of the electropsychometric demonstration occurred unexpectedly when the mother, as I was wholly unaware, was seated in the audience, came to the microphone and disclosed that the "fantasy" of the attack by the cow was substantially correct, that the recalls in analysis were, in fact, in some respects ALMOST PRECISELY AS BROUGHT UP DURING THE DEMONSTRATION. THAT SHE WAS ATTACKED BY A BLACK-AND-WHITE HOLSTEIN COW THAT HAD JUST GIVEN BIRTH TO A CALF, THAT SHE ESCAPED BY JUMPING OVER A FENCE, THAT THE BABY WAS SOMEWHAT PREMATURELY BORN SEVERAL HOURS LATER, THAT IT BEGAN EMERGING WITH THE LEFT SIDE OF THE HEAD PROTRUDING FIRST AND WAS FORCED BACK BY THE ATTENDING PHYSICIAN, REPOSITIONED, AND THEN WITHDRAWN WITH FORCEPS. Ether was administered to the mother.

The patient apparently obtained adequate conscious awareness and insight through the use of the fourth technique described in the manual (Refer to "FIVE Successful Basic Techniques of Psychotherapy, as Known in 1955" for details.) The symbolical, or key, words employed were: COW, SCREAMS, CUT, ETHER, PUSHED BACK, SMOTHER, BREATHE AGAIN, TONSILS, ADENOCIDS, APPENDIX.

The mother states that the details of this prenatal event had never been related by her to her son; that in fact she had completely forgotten some of the more painful parts of the experience. Whether she had previously related something of the incident to the patient is of course open to debate, or at any rate can hardly be definitely established one way or the other.

Nonetheless, the major purpose of the demonstration was achieved: to show that MAJOR PSYCHIC TRAUMAS CAN BE PINPOINTED QUICKLY by Electropsychometric techniques--sometimes in a few minutes--and that the modernized Freudian-based techniques recommended and taught with Electropsychometry may be effective.

## MATHISON ELECTROPSYCHOMETERS



# ELECTROPSYCHOMETRIC CASE ASSESSMENT \*

*Technique for reducing conscious awareness of hand electrode*

The therapist who is using an electropsychometer for the first time will observe that meter registrations can be affected by purposely squeezing on the hand electrode.

From the standpoint of case assessment or monitoring of therapy, this is a transient effect. The registration of the patient's mode of gripping the electrode, as SUSTAINED OVER A PERIOD OF TIME, that is, for a period longer than two or three minutes, is the significant mode, and the only one to be considered.

Superior results are obtained when the patient's conscious awareness that he is holding the electrode has been reduced as much as possible. The best technique for doing this, so far evolved, is presented, by way of example, in the form of an actual address to a patient:

"Please hold this electrode in whichever hand you prefer. Squeeze as hard as you can on it. Relax. Squeeze again. Relax. (Repeat at least six times.)

\*\*\*\*\*

The following additional technique has been found very useful, especially if the patient is restless and has a tendency to keep moving the electrode about or to finger it nervously.

"Examine the electrode. Look it over. Take hold of it again. Squeeze it. Become aware of the feel of the metal surfaces. Imagine that this metal is becoming warm. Hot. Very hot. Now, imagine it is cooling back to normal.

"Imagine it is becoming cold. Icy cold. Return to normal. Imagine it is becoming small. Return it to normal. Imagine it is becoming large. Return it to normal. That is is becoming heavy. Very heavy. Return to normal." (Creating an illusion of being able to vary weight is to be emphasized; it is the key item.)

"Now, let us see if you and I can come to a very specific agreement. This agreement is that you can imagine that this electrode does not really exist. That it is just an illusion of weight and mass. Nuclear science finds that all matter is to some degree an illusion of weight and mass. So, in a moment, we are going to have you imagine that the electrode is again getting extremely heavy. Then you are to MAKE YOUR OWN DECISION that you can cause it to feel lighter and lighter and less real, until you reach the illusion that it has no weight or mass. By your own decision, you can become unaware that you have the electrode in your hand, though you will always know subconsciously that it is there.

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(Having obtained the above agreement, or something similar) "All right. Just make yourself comfortable. Place your hand in a restful position." (Do not let patient hold electrode up in some awkward elevated fashion.) "You are not at any time to hold the electrode with both hands. Place your free hand by your side, well away from the electrode." (If patient persists in tending to seize the electrode with both hands, place a light towel over hand with electrode.)

"Now we're ready. Imagine again that the electrode is growing heavy. Heavier. Heavier. Very heavy. Still heavier. Now slowly let it become less heavy. It's not heavy any more. Make it lighter and lighter. Let your subconscious mind now take over holding the electrode. Bring into action your own decision not to be aware of the electrode until we end this session. You will not tap on it with your thumb or fingers. You will not move it around. You are no longer interested in it. You don't care what happens to it."

\*\*\*\*\*

The efficacy of the above technique varies. Some patients will become completely unaware of the electrode. All seem, to some degree, to become less conscious of it than before. If the above procedure does not work the first time it is tried, repeat it.



*Technique for reducing interrogation anxiety.*



As soon as conscious concern about the electrode has been reduced, the next essential procedure is to check for "interrogation anxiety." In many cases, there is an excess of anxiety about being asked questions. This is manifested by the surge-meter needle registering sharply in response to every question asked. The surges are as violent on mild, impersonal queries as on personal questions. The standard test question to be used is:

HOW DO YOU FEEL ABOUT BEING ASKED QUESTIONS?

Sharp needle response discloses that there is over-anxiety in this area. This must be reduced. To do this, simply induce the patient to talk freely about the most easily recalled past situations wherein he was painfully quizzed by some person. Try to pick up only major situations. The sharpest ones are apt to involve MOTHER, TEACHERS, POLICE, etc. The most typical are mother's "Where have you been? Whom were you with? What did you do? Did you hide it? Who broke it? did you steal it? What have you and that girl been doing? etc.

Have the patient talk some of these things out before making a general assessment of the case. Sometimes the reduction of interrogation anxiety will of itself present the therapist with clues concerning certain psychic traumas in the case.

--- Volney G Mathison





# MATHISON ELECTROPSYCHOMETERS \*

U.S. Patent 2684670 July 27 1964

## tone meter recalibrating instructions

MODEL E-400-A & MODEL E-AR-400

### IMPORTANT NOTICE TO ALL USERS

Before using instrument for the first time, and occasionally thereafter, make the following "OFFICE CALIBRATION TEST." This aligns all scales:

Set TONE SCALE SELECTOR switch, the large control knob at lower left on the front panel) at the "D" position, fully turned to the right.

2: Push in or pushbutton just above the TONE SELECTOR switch. Slowly turn rotatable knob back on REAR of chassis of instrument, until needle of the TONE meter reads a full "2" on the "D" scale. MAKE THIS ADJUSTMENT WITHOUT patient holding hand electrodes. This adjustment aligns all scales.

### tone meter circuit data

Fig. 1 shows the circuit connections of the tone meter section only of the instrument. Values are as follows, with reference to the numerals on diagrams:

Numerals 13, 27, 14, 560 ohms. 36 is a bank of five 500k potentiometers. 30 is a 5-contact switch. 25, a 6SF5 tube. Normal voltage between terminals 11 & 12, approx. 100 volts. Conductors 15 & 16 in patient electrode cord go through plug-socket prongs #s 7 & 8 for one conductor, and prongs 1 & 2 for the other conductor with reference to plug socket on rear of chassis. Rotary "office calibrating check" control on rear of chassis is a 10k pot.

### COMPLETE RECALIBRATING PROCEDURE

Refer to Fig. 2. The round circles are the ends of the shafts of the potentiometers that control the readings on the five scales of the TONE meter. Each circle in Fig. 2 bears the symbol of the corresponding scale of the TONE meter that it controls.

Calibration is effected with a simple kit consisting of a dummy plug with two short white cords terminating in small "alligator-nosed" clips; and a set of four resistors, which are to be inserted one after the other into these dummy plug clips in the order that follows:

1: Set the rotary knob on rear of chassis, referred to above as the "office calibration check control" to about midway in its arc of rotation. This is, usually, with the point of the knob turned straight upward. Set it so that it can be turned about the same distance in either direction. THEN DO NOT MOVE IT WHILE RECALIBRATING AS INSTRUCTED BELOW.

2: Remove patient electrode cord plug and insert dummy plug with the short wires and clips. Turn on instrument and warm it up four minutes.

3: Put a 22k resistor in the clips (COLORS ON BODY OF RESISTOR ARE RED, RED, ORANGE, SILVER.) Put wire on one end of the resistor in one clip, put wire at opposite end of resistor in other clip. With a screwdriver or pliers, break duco seal on "D" pot shaft (See Fig. 2) and gently seal on "D" pot shaft (See Fig. 2) and gently turn until needle of TONE meter reads at a full "2" on scale "D."

4: SHIFT SELECTOR SWITCH TO "C" POSITION. Insert 56k resistor (GREEN, BLUE, ORANGE, SILVER) in dummy-plug clips. Adjust shaft of the "C" pot until TONE meter needle reads 2.5 on the "C" scale.

5: SHIFT SELECTOR SWITCH TO "B" SCALE. Using the same 56k resistor as above for "C" scale, adjust the "B" shaft pot until the needle reads at 2.5 on the "B" scale.

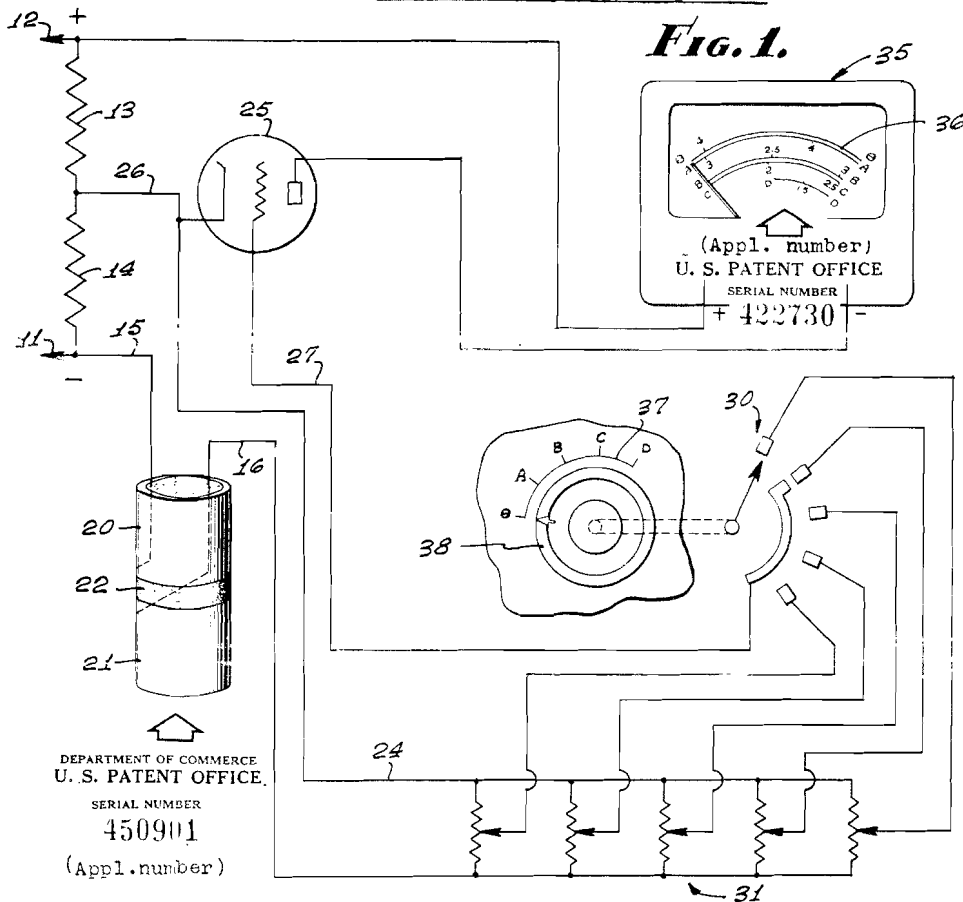
6: SHIFT SELECTOR SWITCH TO "A" SCALE. Insert 100k resistor (BROWN, BLACK, YELLOW, BROWN, SILVER) in dummy-plug clips. Adjust shaft of "A" pot until TONE needle reads at about 3 or a bit less on the "A" scale.

7: SHIFT SELECTOR SWITCH TO "e" SCALE. Insert 330-k resistor (BROWN, ORANGE, BROWN, ORANGE, YELLOW, BROWN, SILVER) in plug clips. Adjust shaft of "e" pot until needle is at about 4.5 to 4.7 on "e" scale. This scale is rarely, if ever used. It may have a future use.

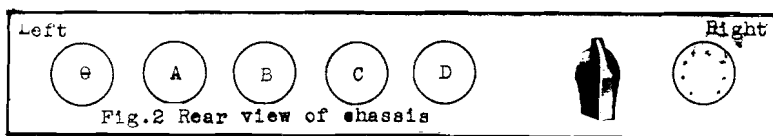
IMPORTANT! Be careful, when recalibrating, that TONE selector switch is always set at the correct position to match the value of the resistor in the plug clips, and that you are reading on the CORRECT SCALE of the meter. A frequent mistake is to forget to transfer TONE switch as each resistor is changed, in dummy plug clips.

When finished, recement pot shafts with two or three drops of ordinary clear duco cement (may be obtained at any hardware store.)

(Circuit as shown in Fig. 1 is NOT complete; it is published for recalibrating purposes only)



"OFFICE CALIBRATION TEST" CONTROL





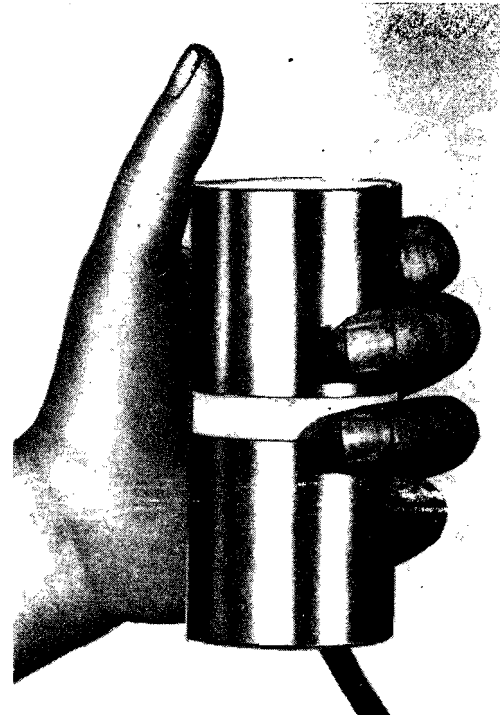
# MATHISON ELECTROPSYCHOMETERS

*Electrodes used with the  
Mathison Electropsychometer*

## MATHISON DUAL CONCENTRIC HAND ELECTRODE.

Lathe-turned duraluminum electrode, complete with cord and plug. Registers simultaneously both galvanic skin reaction and neuromuscular reflexes.

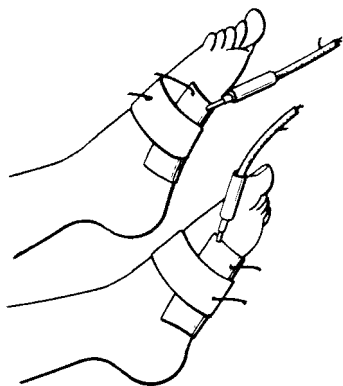
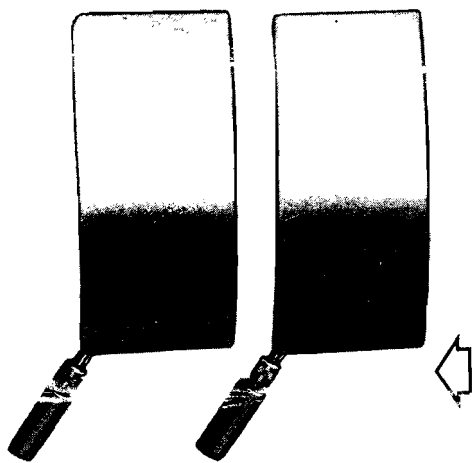
(U.S. Patent appl. number 450901)



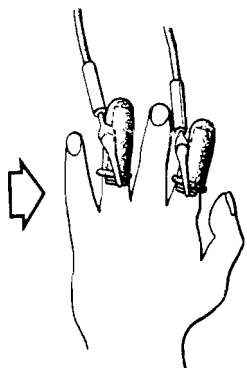
## MATHISON INSTEP ELECTRODES

Illustration shows stainless steel convex contacting plates. Furnished complete with cord, insert plug, and Scholl elastic arch straps.

Photo below shows mode of use.



Stainless steel finger - spring electrodes. Can be supplied on order.



Search probe electrode. For detecting subluxations and the like. Usable only with Model AR-5 and E-AR-400 type instruments. Supplied complete with cord and insert plug.





Mathison-licensed  
**ELECTROPSYCHOMETERS**

*PATENT NOTICE: This instrument is manufactured by International Equipment Trust under one or more of 73 patent claims, pending or granted, assigned by Volney G. Mathison to M. N. Warkentin and or Arcon Investment Co., licensors.*

PRICE LIST

NOTE: The Model E-400-A is the preferred instrument for the PSYCHOLOGIST, THE ANALYST, THE PSYCHOTHERAPIST. It is used for every type of psychical examination or for EMOTIONAL REFLEX RESPONSE testing.

The Model E-AR-400 contains all the components of the E-400-A PLUS a complete seven-tube probe circuit and search probe for locating areas of hyperemia and conditions of subluxation, impingement, and the like. HENCE IT CAN BE USED AT ONCE, WITHOUT SPECIAL TRAINING, BY THE PROFESSIONAL CHIROPRACTER, OR NEUROLOGIST.

MODEL E-400-A--The standard automatic instrument for electropsychometric assessment, and for ANY psychotherapeutic procedures Price, complete with Operating Instructions and 2-volume Manual "Electropsychometry" . . . . . \$248.50  
Width 14"; depth front to back 8"; height overall 10"; weight 18 lbs., shipping weight 30 lbs., foreign 60 lbs.

MODEL E-AR-400--Two complete instruments in one. Contains the automatic-electropsychometer components of the Model E-400-A plus the circuit and components of the Model AR-5. For exploratory probe tests for areas of hyperemia and conditions of subluxations or the like. Price, with Manual "Electropsychometry". \$385.00  
Width 14"; depth 12"; height 11"; wt. 28 lbs.; shipping wt. 45 lbs., foreign 85 lbs.

DELUXE MODEL of E-AR-400--Same as standard model but with larger, chrome-trimmed cabinet, and compartment for hand electrode and probe. Price, complete with Manual "Electropsychometry" . . \$425.00  
Dimensions 18" long, 14" deep, 10" high; weight 37 lbs.; shipping weight 55 lbs.

MODEL HM-4--The current model of the world-famous original handset Mathison Electropsychometer. (For dimensions refer to illustrated descriptive pages.) . . . . . \$125.00

Mathison Minimeter--Not an Electropsychometer, but a high-quality usable device. Less Manual . . . . . \$ 35.00

BOOKS and ACCESSORIES

Manual "Electropsychometry". Two volumes. Both, postpaid . . \$ 3.75  
CREATIVE IMAGE THERAPY, postpaid . . . . . \$ 2.00  
Dual-concentric Hand Electrode . . . . . \$ 6.00  
Instep Electrode Kit, complete with elastic straps . . . . . \$ 5.00  
Finger-spring Electrode Kit (stainless steel) . . . . . \$ 5.00

It has been observed that the general nervous tone of a patient receiving any type of mental therapy is usually in a state of rapid fluctuation from moment to moment. The relative values of these continuously varying emotional stresses registering in the nervous structure of the patient is followed rapidly by the indicating needle of the Mathison electropsychometer.

The electrical pick-up from the patient is made through flexible cords and electrodes which are held by the patient in a relaxed manner, as he lies on the couch. This arrangement is similar to that used with psychogalvanometers. The responses of the Mathison instrument, however, are remarkably faster, sharper, and more informative than any previously obtainable with any instrument sold at anything like a comparative price.

When data that restimulates even a slight degree of nervous tension is spoken aloud or only mentally contacted by the patient without spoken words, a rapid surge of the indicating instrument occurs. Recalls causing relatively high tension register with correspondingly strong surges of the indicator.

The absolute nervous tone readings indicated by the electropsychometer are of variable degrees of validity; but the relative values of the tone level, as shown during successive time intervals are of great significance.

The instrument discloses tensions associated with past incidents in the case. Very often it registers high tensions associated with words or statements that the patient will smilingly insist are of no importance whatever.

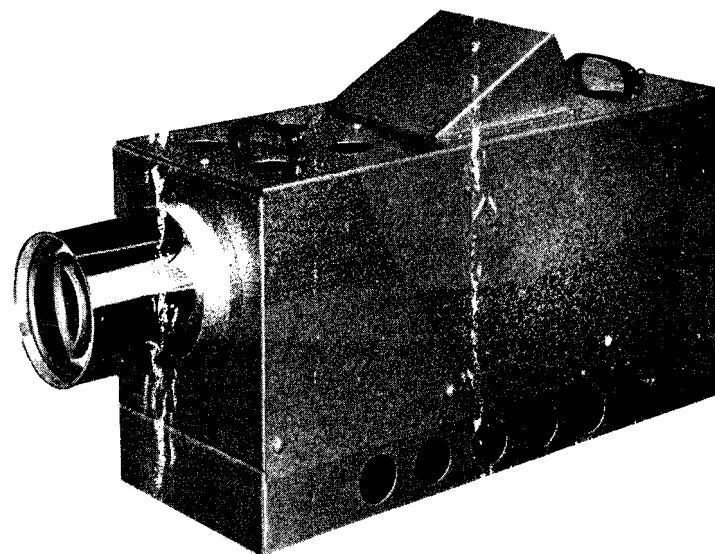
**It has been found repeatedly that an entrance into important aspects of a case may be obtained with the electropsychometer that would otherwise have been avoided or misrepresented by the patient.**

In the standard Model B instrument shown on Page 3, tensional surges are observed directly on a 4½ inch indicating meter scale.

The special projection-type instrument illustrated at upper right has a transparent meter-scale; and the scale and pointer are mounted in a light-beam in series with a system of lenses, so that an enlarged image of the indicating scale may be projected onto a screen. Meter images up to 7 feet or more in length may be projected. This results in tremendous effective sensitivity with high stability and complete freedom from technical adjustments.

### Model A Projection-type Electropsychometer

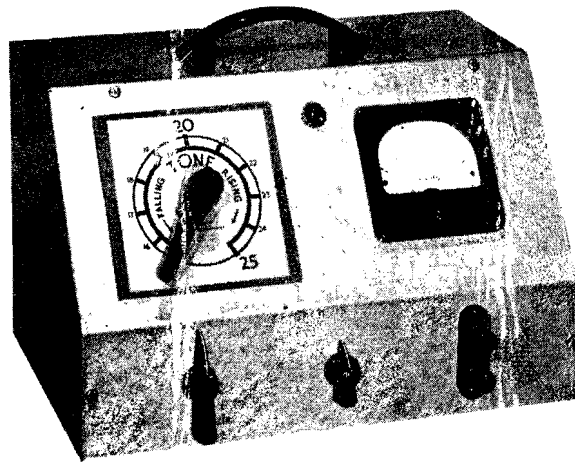
For clinics, schools, lecture use, and for private use by the psychoanalyst or mental therapist who can afford the higher cost of this model. An outstanding application is for the rapid examination and screening of industrial employees.



### Features of all Mathison Electropsychometers:

1. HIGH SENSITIVITY
2. VERY RELIABLE
3. ACCURACY OF FUNCTION:  
The instrument usually registers REVERSED RESPONSES to "games" or deliberately invented or false data.
4. LOW COST. Results are superior to any obtainable with instruments sold at higher prices.
5. EASY TO USE: No difficult or delicate adjustments. Detailed operating instructions furnished with every instrument.

# Model C Electropsychometer



This model has a 3-inch scale and is recommended for students only. A usable and practical instrument, suitable for occasional work, and for the study of mental therapies, especially those of the Korzybski semantic types.

**WARRANTY:** Meter-analyzer movement is not warranted against burn-out caused by tampering with seals, or by misuse of instrument. Every instrument is otherwise guaranteed for one year against failures due to defective materials or workmanship.

All instruments are shipped complete with cords and electrodes. All operate on 110 AC current. Where no current source available, a battery-operated powerizer may be used. Prices on application.

## ARCON MFG. CO.

144 West 30th Street  
Los Angeles 7, California  
REpublic 3-1932

Sold by

## HAYS & BARRETT

465 Capital Street  
Oakland 10, California

Telephone: Glencourt 2-0132

# MATHISON ELECTROPSYCHOMETER

U. S. PATENT NO. 2,487,024. OTHER PATENTS PENDING

An instrument that is showing definite results in the fields of psychoanalysis and psychotherapy. Reliable, sensitive, and inexpensive.

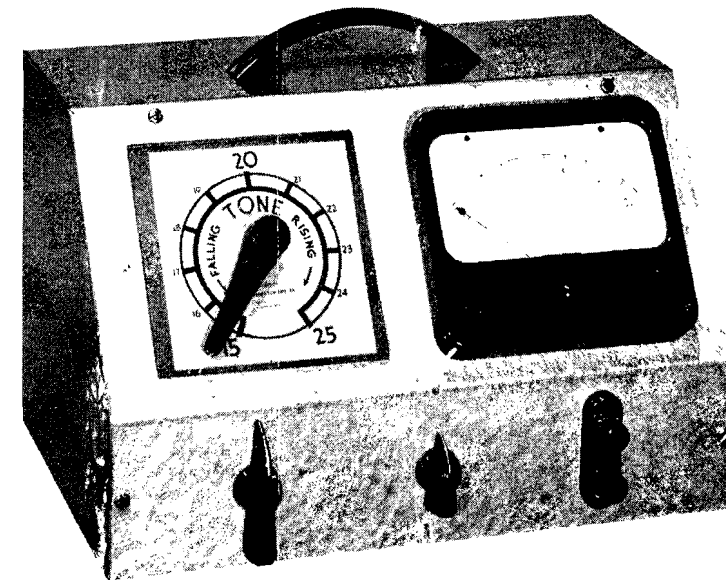
A valuable aid to

PSYCHIATRISTS

NEUROLOGISTS

PSYCHOLOGISTS

MENTAL THERAPISTS



Model B Portable

Professional Model

The Mathison Electropsychometer visually indicates the relatively varying degrees of nervous tension being experienced by a patient who is undergoing any kind of mental examination or mental therapeutic treatment.



# ELECTROPSYCHOMETRY

## A new, more effective and faster Psychotherapy

By MARK L. GALLERT,

FREUD'S most valuable contribution to psychotherapy was not his emphasis on sex, but rather the fundamental principle: that memories of past painful experiences are repressed and driven down into the subconscious, and then induce problems, symptoms and adverse physical and mental conditions in later life. This principle is basic to a workable psychotherapy. The resulting deviations from optimum condition both physical and mental—can be designated by the single word—aberration. The problem of the psychotherapist is simply — How can aberrations be most easily and quickly cleared away? Psychoanalytic, psychiatric and psychological procedures are lengthy and slow, in their attempts to recall and discharge past painful memories that lie behind the patient's aberrations.

New concept and research have led to the developments of techniques that are far faster, more precise and effective. This new field is termed electropsychometry. A few of its basic principles are:

1. That memories of past painful experiences are stored in the person by means of electronic energy patterns, which represent distortions of normal energy patterns. The greater the number and severity of these distortions, the more aberrated is the person.

2. By the use of certain new techniques of mental visualization, the electronic energy bound up in those distorted energy patterns can be discharged and the discharge noted on the meter of a simple and inexpensive instrument termed the electropsychometer.

3. As those electronic energies are discharged, the physical and mental aberrations which resulted from the repressed memories of past painful experiences disappear with a rapidity hitherto unknown in psychotherapy.

4. New concepts have clarified the relationships between past painful experiences and present aberrative symptoms, so that the Electropsychometrist, by observing the patient and referring to these concepts, can deduce the type of painful situation that produced the patient's present aberrations and can therefore select the most appropriate type of visualization technique to suggest to the patient, for effective and thorough discharge or catharsis.

Applied knowledge and deduction by the Electropsychometrist thus replaces the previous slow process of inducing the patient to recall his forgotten past.

5. The mental visualization techniques, when properly selected and applied, reach the subconscious level and cause discharge of aberrative energies even though conscious recall is not obtained by the patient. Furthermore, some of these techniques discharge past accumulated pain concerning whole groups or categories of incidents, eliminating the previous necessity of going over them one by one. In other words, psychotherapy can now function on a "wholesale" rather than just a "retail" basis—another reason why the results have been speeded up, to the point where 10 to 30 hours now can accomplish what formerly required 50 to 200 hours or more.

6. Application of the remedial techniques is greatly aided by the use, during therapy, of the electropsychometer. This helpful instrument discloses constantly and instantly, whether a discharge of aberrative energies is taking place, and also discloses the speed of discharge. Thus the Electropsychometrist knows at all times exactly what is being accomplished, in contrast to past procedure where the psychotherapist had to wait

for weeks or months before learning what effect the therapy would produce. With the Electropsychometer's guidance, techniques can be rapidly taken up and laid aside, until the one is found which produces maximum discharge for the patient at that particular time. Thus the Electropsychometer takes the guess-work out of psychotherapy and makes it possible to utilize the patient's and therapist's time to maximum advantage.

This technology for the elimination of the psychosomatic component of illness, is a "natural" for drugless Doctors, for Electropsychometry has proven that mental, emotional and temperamental disorders have an important factor in common with findings of the drugless schools for physical disorders. By adjustments and manual manipulations you are able to normalize the *physical energy flow* in the body as represented by nerve currents. With Electropsychometric research, it has been discovered that subconscious memories of past traumatic incidents are perpetuated in the person by recordings on the energy patterns of the cells, and it is these recordings, or distortion of energy patterns, which maintain and perpetuate psychosomatic difficulties. Further, that by dissipating the energy involved in those recordings, the traces left by painful past events no longer can distort the personality.





A group of students receiving electropsychometric instruction. Many more registered electropsychometrists are needed.

through interfering with your rest. Research indicates there may be little of value in all-night "sleep therapy" systems.

#### WHERE IS MY NEAREST ELECTROPSYCHOMETRIST?

A large and steadily increasing group of electropsychometrists are registered on our index. We supply the name of the nearest APPROVED operator on request. You may obtain this by writing to either the Institute of Self-Hypnosis or to Mathison Electropsychometers, or by telephoning Los Angeles REpublic 2-5024 at any hour of the day or night.

A registered electropsychometrist, as has been already stated, is a person who has the necessary electronic equipment and who is able to administer the 68 questions of the Mathison Electropsychometric Chart. This is a straight-

## HOW TO BEGIN AT ACHIEVING TOTAL CERTAINTY

This brings into focus now, the sharp and final question: how can multitudes, and not just a rare few, create in themselves a faith, an intensity of mental or psychical imaging that amounts to this essential certainty that the image will be manifested in reality.

One useful and workable answer indicated in electropsychometry is that the certainty of faith can be deliberately created through step-by-step exercises. It can be gradually created in the same way that ever so many physical weaklings develop themselves into sturdy specimens. They accomplish this by a process of sustained psychical imaging accompanied by dynamic physical action.

The basic precept here appears to be to START SMALL at purposefully creating a mental image of some minor positively achievable physical act, then physically to perform that act, and in the performing of it, to be aware intensely on the conscious level that even this is actually a manifestation of the realization of an image.

The technique goes this way: Place a pencil before you on the table. Create a mental image, as vividly as possible, of picking up the pencil. Then pick it up--and as you do so, be consciously and intensely aware that you have validated a mental image on the physical level. Duplicate, that is, repeat the entire procedure again and again and again. Other exercises, similar in principle, will suggest them-

Now, I had some of these problems myself about ten years ago. So, I went to many types of councilors, psychoanalysts. This took a lot of time. It was very expensive, and nothing good came out of it. Why did no good come out of all that? Well, I didn't know the answer to that question at that time but I certainly do know the answer now. The reason was that none of these practitioners had the least idea as to the basic causes of my severe tension. Some promised me that eventually we would find out all this. But all uniformly let me know that it would take many months and that the cost would be a good many thousands of dollars.

All this was not encouraging. It was even less encouraging when I began investigating the field of conventional psychology and psychoanalysis and found that the men practicing in these fields privately admit to and among themselves, that they have about 66 per cent failures. All those failures after so much time and so much money spent. This did not appeal to me. It does not appeal to most people who can hardly afford to spend all that money for such doubtful results. So the average person tends to back away from all of this, and quite rightly, too.

In my own personal case, however, I happened to have what is professionally known in the psychology business as a compulsion. Before I was born, my father read to my mother every night from a book named, "Progress and Poverty", by Henry George. This book extensively, gently, but very thoroughly debunks old-style politics. And, every night, at the end of reading a chapter, my father would say to my mother: "So, you see, you have to find out the facts. You have to find out the facts." So after I was born, my mother named me George, after this gentle debunker, Henry George. And I have been stuck with the compulsion ever since to find out the facts. So, I have gone part way around the world some 30 times or so, finding out all kinds of facts in all kinds of countries. Finally I wanted to know why I kept doing this and that in part is how I came to meet my first psychoanalyst. And right there I began finding out a whole new lot of facts, the main one being, perhaps, that most psychoanalysts are a thoroughly mixed-up bunch of characters who don't even know what is wrong with themselves much less with their patient. They do not agree on the importance of biogenetic causes on prenatal causes on sex-based causes.

I started to say that no two of them ever agree on anything, but this would not be correct. For there is one thing that all psychologists and psychoanalysts and psychiatrists agree upon without exception. So, let's start from there. This universally agreed upon fact is, putting it in over-simplified terms, that you have both a conscious and a subconscious mind. This is a fact. But now, if you have heard and read a lot of stuff to the effect that you have even as many as three minds, one called a censor, another called the conscious mind, and finally a real low-down dirty, nasty mind called the Id, the lower mind, the carnal mind, etc., etc.

nique are apt to cause a tone drop, as the instructee contacts the pain and tension in the troubled area. After a few passes, the needle of Meter #15 should begin to drift to the LEFT in the direction of rising tone. If it does not, discontinue and do something else. Also, when the needle ceases drifting to the left, the technique is probably exhausted for the time being. It will usually work again during the next session.

### Flow Technique No. 6

#### REVERSING FLOWS OF BEING, DOING, HAVING

This technique is a variant of Technique No. 3. It applies especially to things the instructee desires or needs to DO, to BE, to HAVE.

For example, let us assume that the instructee wants to get a better job. Proceed somewhat in this manner:

"Image up going into a suitable place, dejectedly asking for a job. See yourself being sneered at, rejected, perhaps even being physically kicked out. Make the routine sharp, vivid, and very brief. The purpose is to bring you to an awareness of the type of energy flow pattern you are using to get this rejection.

"Now intensely image up going into this same place, in a serene and positive manner, and with a total certainty that you will be accepted. Become aware to the highest possible degree of the different energy flow pattern you use to achieve this. A flow that is diametrically the opposite



of the first one that caused rejection."

Have the instructee dismiss the imagery, relax, then completely repeat, that is, duplicate, the whole procedure. As usual, Meter #15 must be watched. The first two, three, or four runs may cause a tone drop, then it should begin to rise. If it does not rise, discontinue. If it does rise, continue until needle action dies out.

Assume instructee wishes to be liked. Again image up being blue, dejected, disliked, rejected. Briefly but sharply feel the type of energy flow pattern being used. Reverse this energy pattern; image up being gay, liked, accepted, desired. Duplicate!

Assume the instructee wishes to have more money. Image up being broke, penniless, ragged, starving. Make it swift, vivid, brief. Feel the energy flow being used. Now, reverse this; image up earning, having, receiving adequate money and other desired items. The imaging of this must NOT be on the basis of receiving money or anything else as gifts, coming in without effort, but on the contrary, on the basis of exercising one's own innate energy-flowing and event-achieving power.

This technique can be used with reference to reversing fatigue to buoyancy, sleeplessness to sound sleep, nervousness to serenity, fears and anxieties to a calm certainty of wellbeingness.

The above technique is one of the "dichotomies". It simply amounts to "I can't--I CAN!", and being highly aware of the type of energy flow pattern being used each way. It

---

## DESCRIPTION

The Electropsychometer is a new and powerful aid, when used for the purposes for which it has been designed. Retains the basic patented Mathison Electropsychometer circuit, but is completely automatic in operation.

The most valuable feature of all Mathison Electropsychometers is that this instrument consistently differentiates between pleasant and painful human emotions. Other devices of this type surge on any emotion, indiscriminately. The Electropsychometer discloses psychophysical "tone-drops" on relatively painful recalled events, and "tone rises" on less painful or more pleasant recalls.

*WARRANTY: This instrument may be expected to out-perform any known similar device, regardless of price. Returnable for cash refund after ten-day trial. Warranted for one year against failures due to defective materials or workmanship, provided welded antitampering seals are unbroken.*

Finish: black crackle, white silk-screened legends and panel bordering. Highest quality meters, large smooth-running controls. 14" wide, 10" high, 8" deep. Weight 22 lbs. Packed, 30 lbs. Operates on 110-AC. Six rugged standard-type tubes. Operating instructions included.

---

## INSTRUCTION PROGRAM

presenting

## THAT "WONDER INSTRUMENT"



## THE ELECTROPSYCHOMETER

The  
**PSYCHIC X-RAY**



**TOWN HOUSE HOTEL**

Kansas City, Kansas  
November 5-6-7th

## FIRST DAY

Friday — November 5th

9:00 a.m.

THE NEED OF A PSYCHIC X-RAY and the quest for it.

This one-hour talk will explain to you that authorities claim that a GREAT percentage of diseases—at least 75% — have their ORIGIN in the PSYCHIC part of your patient. We have long searched for an instrument that would enable us to reach and understand these causes. Take MIGRANE, for instance. THERE IS NO KNOWN CAUSE IN THE PHYSICAL — yet — many cases have responded very quickly at the CONCEPT-THERAPY INSTITUTE clinic when we were successful in discovering the PSYCHIC CAUSE. This lecture will acquaint you with the absolute need of SOME INSTRUMENT—some method—of locating CAUSES of PHYSICAL DISEASE lurking in the PSYCHIC part of your patient.

10:00 a.m.

THE CONCEPTION AND DEVELOPMENT OF THE PSYCHIC X-RAY.

Mr. Volney Mathison, the inventor of the PSYCHOMETER, will inform you of the conception of the IDEA which led to his remarkable invention. You will be told of the difficulties an inventor encounters perfecting an instrument that will be approved and granted patent rights by the United States Patent Office.

11:00 a.m.

EXPLANATION OF THE ELECTROPSYCHOMETER. — Operation Instructions.

It's really very simple to learn to operate one of these wonderful instruments, but as there will be present in the audience many Doctors who have purchased one, we will give instructions in cadence so as to be assured that each and all will KNOW HOW to operate the instrument.

12:00 noon. Recess for Lunch.

1:00 p.m.

PHYSICAL DIAGNOSIS AND ITS RELATION TO THE CONCEPT.

In this talk you will learn a simple, yet effective, method of PHYSICAL DIAGNOSIS which has

stood the test of 20 years. The IMAGING FACULTY of man will be explained so that you will KNOW that behind each and every disease there is — must be — an IMAGE, and from this IMAGE comes the CONCEPT which is followed by the disease. Even accidents come under this classification. This revelation is well worth your time and effort spent in coming to Kansas City.

2:00 p.m.

THE SIX ANATOMICAL ZONES IN HEALTH AND DISEASE.

Herein are explained the 6 zones used in CONCEPT-THERAPY DIAGNOSIS. These are anatomically correct and can be proved by GREY'S ANATOMY. You will learn to look for — find — and understand these zones. And, instead of having thousands of NAMES of diseases, you will have only SIX DISORDERS OF THE BODY TO DEAL WITH. The Electronic Instrument which we are demonstrating will PROVE these zones.

3:00 p.m.

MUSCULAR DISTURBANCES OF THE SIX ANATOMICAL ZONES.

This lecture reveals that whenever a ZONE is out of harmony certain muscles are involved. The instrument will then pick up and register this disharmony. Not only will you know the muscle or muscles involved but you will learn just what to do to bring about a correction. No guesswork here.

4:00 p.m.

THE USE OF THE ELECTROPSYCHOMETER PROBE ELECTRODE to find painful, diseased areas in the PHYSICAL BODY.

This instrument does everything but talk. In lieu of talking and telling you where the trouble is, it makes a noise which is uncanny. And this NOISE tells you of the trouble. You will have to SEE THIS — operate it on your own body to appreciate it.

5:00 p.m. Recess for Dinner.

7:00 p.m.

THE MISSING LINK IN THE HEALING PROFESSIONS.

This lecture is one which you cannot afford to miss. It will give you an insight into the problem which confronts a Doctor — ANY DOCTOR — who does not have a way to reach the patient's INNATE.

8:00 p.m.

**TESTIMONIALS FROM OUR BEAMERS WHO  
PURCHASED AND HAVE BEEN USING  
PSYCHOMETERS.**

Your own friends — BEAMERS — will explain to you their experiences during the past three months with this WONDER INSTRUMENT. They will tell you of old chronics whom they had as patients for years and how, with this new device, they are now getting rapid results. Doctors will tell you how they use the instrument — upon themselves — to remove disturbances that arise during a busy day. You will enjoy this to the utmost.



**SECOND DAY**

**Saturday — November 6th**

9:00 a.m.

**POWER OF THE MIND OVER THE BODY.**

In this talk you will be convinced — if not already so — that the MIND is a factor which all intelligent Doctors must reckon with. You will be shown how the ELECTROPSYCHOMETER may be used to PENETRATE INTO THE DEEP RECESSES OF YOUR PATIENT'S MIND and UNCOVER hidden causes which heretofore may have kept you from getting results.

10:00 a.m.

**PSYCHOANALYSIS AND PSYCHOTHERAPEUTICS.**

A general description of the origin and development of the ART of dealing with a person's mental equipment. Enlightenment on well-known techniques of mental therapy.

11:00 a.m.

**THE USE OF THE PSYCHOMETER IN  
GIVING A WORD TEST.**

You will be surprised how very easy it is to get your KEY WORDS with this instrument. The most surprising thing is that your patient may try to mis-

lead you with his or her answers to a word, but the instrument will TELL THE FACTS.

12:00 noon. Recess for Lunch.

1:00 p.m.

**CORRELATION OF INSTRUMENT SURGES  
with FREE ASSOCIATION and WORD TESTS.**

Here you receive instruction of a priceless nature. You will be absolutely amazed at what you will see.

2:00 p.m.

**QUESTIONING THE PATIENT TO UNCOVER  
HIDDEN NEGATIVE CONCEPTS.**

How difficult it was for us to FIND THE EXISTING CONCEPT that gave rise to the PHYSICAL DISORDER. Now, with this marvelous instrument, the task is made easy. Quickly, very quickly, you receive the answer.

3:00 p.m.

**FACTORS THAT CAUSE FRUSTRATION.**

This talk is an education in itself, and no Doctor will want to miss it. After returning to your office, you will have a NEW IDEA of what may be wrong with patients. If one has MUSIC in his soul but cannot express it — you have a sick person. Learn to recognize these "round pegs in square holes."

4:00 p.m.

**ART OF SELLING ELECTROPSYCHOMETER  
SERVICES.**

Just think! — one of our Doctors purchased an Electropsychometer. His first patient signed up for services, the compensation for which more than paid for the cost of the instrument.

5:00 p.m. Recess for Dinner.

7:00 p.m.

**PSYCHOMETER CASE PROCEDURE — Gives  
You Priceless Instruction.**

8:00 p.m.

**THE ADVISABILITY — And How To Become A  
Chiropractic Psychiatrist.**

### THIRD DAY

Sunday — November 7th

9:00 a.m.

#### MENTAL TREATMENT.

Nearly everyone is ill—if not physically then mentally or spiritually. Herein we give you a SURE method of taking care of your patient MENTALLY while you are working on the PHYSICAL. Much information given here.

10:00 a.m.

#### HOW TO CHECK AND "CLEAR OUT" PATIENT.

The technique of discharging your patient as a FRIEND—well and happy—will be explained thoroughly.

11:00 a.m.

#### A REMARKABLE NEW DISCOVERY.

Electropsychometers are now being used by Doctors, but WE HAVE MADE A REMARKABLE NEW DISCOVERY WHICH WILL AMAZE YOU. Once you understand this particular method which we will explain here, you will stand in awe of what is really possible with this instrument. Don't take our word for it—COME AND SEE FOR YOURSELF!

12:00 noon. Recess for Lunch.

1:00 p.m.

#### FINDING AND ELIMINATING THE SUBLUXATIONS.

You are going to be agreeably surprised to find that this WONDER INSTRUMENT will enable you to FIND—and assist you to REMOVE—and PROVE your elimination of—subluxated vertebrae.

2:00 p.m.

ADVANCED WORK. Information not yet divulged—GET THIS.

3:00 p.m.

#### CONCERNING THE INSTRUMENT.

4:00 p.m.

THE AFFILIATION of the CONCEPT-THERAPY INSTITUTE with the MATHISON ELECTRO-PSYCHOMETER COMPANY.

### IN CLOSING

In addition to the foregoing program of instruction, there will be ample time for all who attend this class to work with these instruments in the presence of the INVENTOR. We will have 14 instruments in the classroom, and each student can operate to his or her heart's content. You will be shown all operating procedure and can test yourself and others at the instrument.

NOTICE: No obligation for anyone attending this class to purchase an instrument.

### FINAL WORD FROM DR. FLEET:

*To Those Of You Who Purchased An Instrument.*

I promised you that I would provide EXPERT INSTRUCTION. Well, here it is. FIVE EXPERTS are to be assembled at great cost, and we will give you the finest instruction conceivable.

#### TRY TO COME TO THE CLASS.

If, however, you cannot come, then KNOW that in due time some of our CONCEPT-THERAPY teachers—all of whom have been trained in this instrument—will be available later on.

*To Those Of You Who Have Not Purchased An Instrument.*

You may come to this class and take this valuable instruction without the necessity of purchasing an instrument.

We will be glad to have all you BEAMER DOCTORS, and you may bring your wives, technicians, etc.



### THE COST

Only \$50.00 per person.—Enrollment fee must be sent in by mail on or before October 25th, 1954, to Dr. Thurman Fleet—Box 6594, Alamo Heights Station—San Antonio, Texas.

#### No Enrollments At Class

LAST CLASS OF THIS KIND: We could not afford to give another class of this nature as it costs too much. This is our GRAND PREMIERE. Get in on it—Doctor—You will never regret it. "A WORD TO THE WISE."





## The 7 Books by Volney G. Mathison

This seventh volume of the "Seven Books" by Volney G. Mathison has, almost overnight, become a best seller:

# PRACTICAL SELF-HYPNOSIS

*How to achieve and effectively to USE hypnosis without the presence of an operator.*

Presents a supermodern, superstreamlined system for applying the incalculably powerful phenomena of the human mind known to us in this civilization as "hypnosis."

This phenomena — AND ONLY THIS — is the basic key to ALL of the miracle healings, to ALL of the manifestations of extrasensory perception, clairvoyance, and to the workings of all "ancient secret" ways or teachings offered in some expensive books and high-priced metaphysical training courses.

PRACTICAL SELF-HYPNOSIS is the first and only "how-to-do-it" manual of auto-hypnosis. As you read this book, you become aware that it has been created in an intensely busy field of dynamic ACTION. Discloses WHAT TO DO! WHAT NOT TO DO! HOW TO PROCEED!

Eliminate tensions, anxieties, feelings of inferiority, and fears. Develop a magnetic personality. Increase learning and earning abilities. Activate your innate psychical powers!

**Institute of Self Hypnosis**  
P.O. Box 77-144 Dockweiler Stn.  
Los Angeles 7, Calif.

Enclosed \$3 Cash, Check, Money Order, or send COD ☐ for one copy of  
PRACTICAL SELF-HYPNOSIS

Tel. REpublic 2-5024

Name \_\_\_\_\_  
Street \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

## The Secret of the Lourdes Miracles Revealed



by Volney G. Mathison

A scientist, inventor of the patented Mathison Electropsychometer, the world-famous "Psychic X-Ray."

Read the opening lines of this book, —



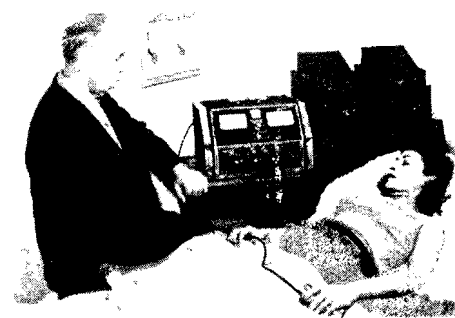
"The miracles dealt with herein are of two types. The first type is that of the miraculous physical healing that occurs at the French shrine of Lourdes--and at many places elsewhere on this globe. The second type of miracle is the swift achievement of happiness and well-beingness in the face of overwhelming obstacles.

"The author has himself experienced an equivalent physical miracle. This occurred thirty-four years ago, therefore it may be said to be a lasting miracle. Since that event, the author has spent years investigating how he achieved what he did. Being a radio communication engineer, his approach has been scientific--and the answer, too, is scientific, clear-cut. It is workable by ANY ONE."

AND--

"High-priced concerns selling 'ancient secrets' assert that the power of psychically or spiritually imaging changes in the human physical body and then causing these changes to appear in the body was exercised in the ancient past and was thereafter lost to humanity.

"The present writer is convinced that this power HAS NEVER BEEN LOST! On the contrary, it has never been fully found. It has been but dimly perceived on the conscious level of human awareness. It has been glimpsed in brief flashes here and there throughout the past centuries of human history. Strange psychical flickerings heralding the eventual GREAT DISCOVERY--how consistently to achieve miracles of accelerated physical and mental healing--appear and vanish again and again. They vanish because there are so many failures. Only a scientific approach with more complete data can reduce the number of failures and make this type of rapid healing more readily achievable. . . ."



This book is based on scientific data obtained through electropsychometric research of the type disclosed in the above photos.

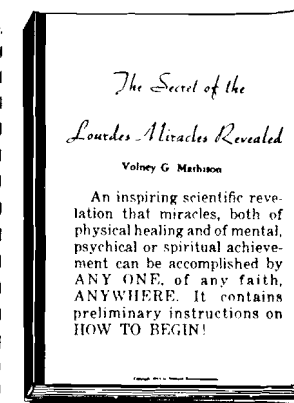
\$2 postpaid. Also available: a tape-recording of the original lecture by Volney G. Mathison; same context as the book. \$6 postpaid.

### Institute of Self Hypnosis

P.O. Box 77-144 Dockweiler Stn.  
Los Angeles 7, Calif

I enclose \$2. Send book: "The Secret of the Lourdes Miracles Revealed."  
I enclose \$6. Send tape-recording of the original lecture by Volney G. Mathison, "The Secret of the Lourdes Miracles Revealed." Same context as the book.

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_  
STATE \_\_\_\_\_



### The Secret of the Lourdes Miracles Revealed

Volney G. Mathison

An inspiring scientific revelation that miracles, both of physical healing and of mental, psychical or spiritual achievement can be accomplished by ANY ONE, of any faith, ANYWHERE. It contains preliminary instructions on HOW TO BEGIN!



Read about this unique and fascinating pendulum. An ideal gift.

# The Mathison Chevrue! Pendulum

by Volney G. Mathison

Inventor of the Mathison Electropsychometer

PICTURE SHOWS  
EXACT SIZES  
EXCEPT THAT  
CHAINS ARE  
LIGHTER AND  
ARE 9" LONG.

About three years ago, serious litigation wherein we were threatened with the loss of our many electropsychometer patents compelled us temporarily to close our electropsychometer manufacturing plant. Casting about for some item to manufacture so as to retain our skilled employees, we came upon the idea of putting on the market the "crystal pendulum" -- more accurately the Chevrue! Pendulum, as named after the French metaphysician who invented it.

At the outset, I regarded the Chevrue! Pendulum as being, in the main, a rather fascinating toy. However, our advertising of the Crystal Pendulum, and later, an accompanying book, "The Secret Power of the Crystal Pendulum", produced a great response, and led to our receiving so many sincere and unsolicited testimonials as to its efficacy that I began to re-examine this device with increased investigative attention. Those who have read my "Creative Image Therapy" are aware that for specific reasons stated therein, I have an innate drive to "find out the facts" about many beclouded situations.

My interest was intensified when we began receiving substantial quantity orders for Crystal Pendulums from Leslie L. LeCron, one of the world's leading ethical hypnotherapists. Mr. LeCron stated that the pendulum -- with a sphere of the specific machine-ground methacrylate type that we manufacture -- was the most powerful aid to the induction of a preliminary stage of hypnosis that he had ever tried, and that he was giving one to every student attending his increasingly large hypno-instruction classes. I was astonished to find that Mr. LeCron's students were all high-quality professional men -- dentists, psychologists, and some medical doctors. This study also resulted in my eventually writing -- under self-hypnosis -- the text of the book, "PRACTICAL SELF-HYPNOSIS -- How to Achieve and How Effectively to USE Hypnosis without the Presence of an Operator." Study under LeCron also led to the resolving of some baffling mysteries -- mysteries to me, at any rate -- about the Chevrue! Pendulum.

The first of these mysteries was that the pendulum would not work for me, personally. It just hung motionless, no matter what questions I thought of -- even after I had manufactured and sold thousands of them. Finally, one day, Mr. LeCron remarked:

"The unusual texts of your electropsychometer patents show that you are extremely scientifically minded. Now, secretly, you are not convinced that the Chevrue! Pendulum is a scientific invention. Therefore every time you try to use it, you are commanding it to remain motionless by saying to yourself, mentally, 'This is not scientific. I will not permit this device to operate. No matter what I think of, it must hang, motionlessly.'"

"That's probably right," I replied. "Well, then, give me your definition of a scientific experiment."

"Why, one which, under like conditions, can be repeated anywhere, at any time, with similar results."

"Now, I would suggest that you try this concept: 'IF this Chevrue! Pendulum IS a valid, scientific instrument, then I can operate it immediately. Therefore, IS THIS PENDULUM A SCIENTIFIC DEVICE?'"

So I again took up a pendulum and asked myself the above question -- and, at once, I obtained a -- to me -- completely astonishing "YES!"

From that moment, the Chevrue! Pendulum has worked just as well for me as it does for everyone else. It has aided, at times, in the resolving of some extremely serious problems.

Also, as I continued to study hypnosis and self-hypnosis, I obtained the resolution of two other related mysteries. The first one was:

WHY does the machine-ground methacrylate pendulum produce responses that are not obtainable with any simpler arrangement, such as a nail or a screw or a button suspended on a string?

The answer soon became apparent: The polished brilliant surface of this sphered material, used under a bright light, aided in the intense involuntary concentration of hypnosis and of self-hypnosis.

This, in turn, also at once resolved the third mystery: Why did the larger professional or super-size pendulum seem to be from two to five times more sensitive than our original size of one-inch diameter? Obviously because the trancing effect of the super-size sphere -- which has exactly twice the physical volume of the smaller size -- has inadvertently been created at the optimum dimensions for achieving the most intensive trancing effects.

So, this explained to me why the machine-ground methacrylate sphere is incomparably superior to any other commercially available substance, and why the professional size -- of the dimensions Mr. LeCron had always insisted upon having -- was far superior to the smaller unit.

One can obtain successful answers to questions on love, job, marriage. ANY problem. For example:

Do I really want to marry Jack?

Should I quit this job?

Do I really hate my boss?

Do I really want a divorce?

Am I pregnant?

Will my coming baby be a boy -- or girl?

It is a scientific certainty that the Chevrue! Pendulum does induce a degree of self-hypnosis, if used under a brightly-lighted table lamp -- and that virtually anyone can get it to operate. Many thousands are in use.

## THE MATHISON CHEVRUE! PENDULUM

A costly highly-polished crystal clear methacrylate sphere on a beautiful 9" chain.

Strictly scientific. Induces light but effective self-hypnosis. Answers questions on love, job, marriage. ANY problem. Detects pregnancy, reveals sex of unborn babe. Tests reactions to foods. Many thousands in use.

PLEASED USERS WRITE:

"Absolutely unique!" "I enjoy its correctness!" "I'd never seen one before, yet it worked for me the very first time I tried it!"

"It is accurate."

"I've given several to friends; every one is delighted with it."

"Worth its weight in gold!"

"Far, far better than I expected!"

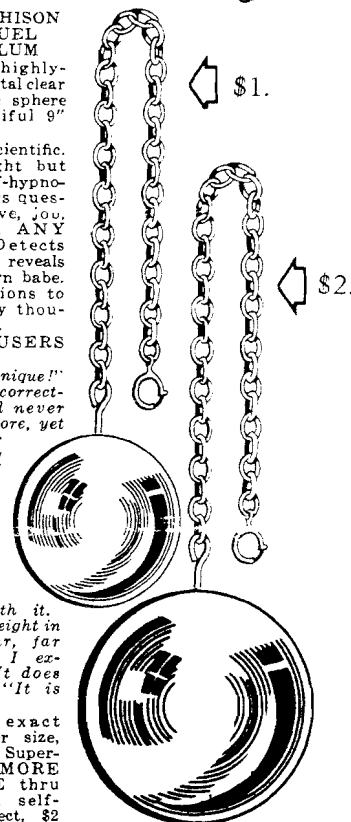
"It does wonders!"

"It is perfect!"

Cuts show exact sizes. Smaller size, \$1 postpaid. Super-size, FAR MORE SENSITIVE thru intensified self-hypnotic effect, \$2 postpaid. Book, described below, \$1 postpaid.

A best seller. Reveals secrets formerly disclosed only in instruction classes at \$100.

Strictly scientific. \$1 postpaid.

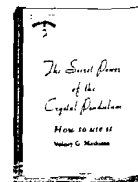


## FASCINATING BOOK

### The Secret Power of the Crystal Pendulum

How to use it

Volney G. Mathison



Clear-cut scientific techniques. Contains chapters on the relation of the response of the pendulum to subconscious processes. How to install a concept with the pendulum. The pendulum as an aid in healing. How to obtain answers to questions; how to use for party entertainment; the crystal pendulum as a talisman. 65 pages 5 1/2 x 8 1/2, \$1. Postpaid.

## Institute of Self Hypnosis

Box 7744 Postweiler Stn.

Los Angeles 7, Calif.

REpublic 2-5024

ENCLOSED check, cash, money order, or request C.O.D.

\$1 for the Mathison Crystal Pendulum. Name \_\_\_\_\_

\$1 for book, "The Secret Power of the Crystal Pendulum".

\$2 for professional super-size pendulum. Street \_\_\_\_\_

\$2 for standard-size pendulum and book.

\$3 for super-size pendulum and book.

(Postpaid)

City \_\_\_\_\_ State \_\_\_\_\_

For AIRMAIL, add 15¢ for either pendulum, 36¢ for book; both 50¢

July 27, 1954

V. G. MATHISON

2,684,670

ELECTROPSYCHOMETER OR BIOELECTRONIC INSTRUMENT

Filed Aug. 1, 1951

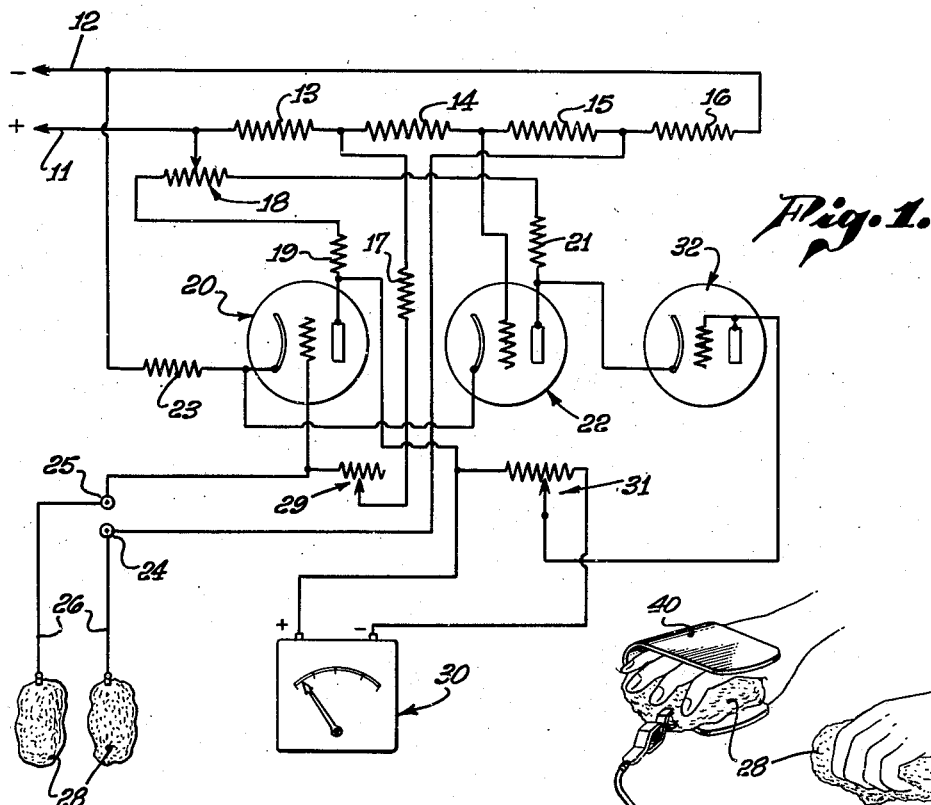
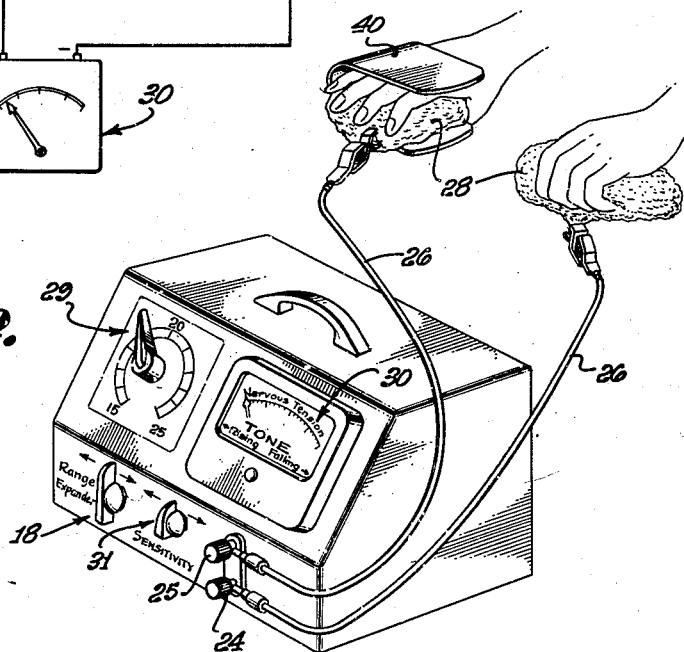


Fig. 2.



INVENTOR.

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## UNITED STATES PATENT OFFICE

2,684,670

## ELECTROPSYCHOMETER OR BIOELECTRONIC INSTRUMENT

Volney G. Mathison, Los Angeles, Calif.

Application August 1, 1951, Serial No. 239,765

8 Claims. (Cl. 128-2.1)

1

My invention, to which I apply the descriptive name electropsychometer, is a novel bio-electronic instrument which registers human dynamic emotion in a more accurate and sensitive manner than has been possible with any previous device of comparable simplicity.

It has been known for many years that if a subject is connected in series with a sensitive galvanometer and a source of low-potential direct current by means of electrodes brought into contact with some areas of the subject's skin, the galvanometer needle will at times register fluctuating values of current flow. Although such variations of current flow are governed, in the main, by the action of the sweat glands in the skin underneath the contacting electrodes, the rate of discharge of fluid from the sweat glands is in turn related to some extent to the activity of the subject's autonomous nervous structure. The approximate general result is that the response of the galvanometric instrument reflects in some degree the immediately prevailing nervous and emotional tone-level of the subject. In the hands of a skilled therapist, the psychogalvanometric arrangement as a whole is a valuable adjuvant in psychoanalysis and psychotherapy. Previous psychogalvanometric instruments, however, have been costly, cumbersome, and in general tend to register in a manner that has been found difficult to evaluate. For these reasons such instruments have up to this time not been much used in actual practice by psychoanalysts and psychotherapists.

My invention eliminates most of the objectionable features of the conventional psychogalvanometer and operates at a much higher level of sensitivity and accuracy. The generic combination of elements comprising my electropsychometer are: (a) one or more resilient and compressible skin-contacting electrodes; (b) a fairly simple type of balanced vacuum tube bridge; (c) a sensitive moving-coil type of direct current microammeter which has its winding connected into the output circuit of the amplifying vacuum tube bridge in series with a current-rectifying element, so that only rectified unidirectional current flows through the indicating instrument.

The invention is illustrated, by way of example, in the accompanying drawing, in which Figure 1 discloses the electrical circuit of the device. Figure 2 is an example of the design of an actual instrument as reduced to practice, showing the operating controls, microammeter, two resilient and compressible skin-contacting electrodes, and an electrode clamp.

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Referring to the drawing, the numerals 11 and 12 denote the positive and negative terminals of a source of direct current, which may be provided by any conventional type of vacuum-tube plate power supply, such as a small transformer, rectifier tube and filter circuit. 13, 14, 15, 16 comprise a group of four resistors connected in series across the plate current supply terminals 11, 12, to form a voltage divider. 18 is an adjustable wire-wound potentiometer. One end of 18 is connected through a resistance 19 to the plate element of vacuum tube 20. The other end of 18 is connected through a resistance 21 to the plate element of a second vacuum tube 22. The cathode elements of vacuum tubes 20, 22, are connected in common to one end of a resistance 23. The other end of 23 is connected to the negative terminal of the plate power supply, 12.

A terminal post 24 is connected between resistors 15 and 16. A second terminal post 25 is connected to the grid element of vacuum tube 20. Two flexible conductors 26 are connected to terminal posts 24 and 25. The other ends of the conductors 26 are connected to two resilient and compressible skin-contacting electrodes 28.

An adjustable resistance 29 is connected to the grid element of vacuum tube 20. 29 is also connected to a resistance 17. The other end of 17 is connected between resistors 13 and 14. A wire is connected from the plate element of vacuum tube 20 to the positive terminal of a direct-current microammeter 30. The terminals of microammeter 30 are shunted by an adjustable resistance 31. The movable arm of 31 is connected to the plate element of a vacuum tube which is connected to function as a highly conductive diode. The cathode element of 32 is connected to the plate element of vacuum tube 22. The grid element of vacuum tube 22 is connected to a point between resistors 14 and 15.

The potential across the terminals 11 and 12 may be of about 250 volts. The resistances may be of approximately the following values: 13, 24,000 ohms; 14, 680 ohms; 15, 680 ohms; 16, 18,000 ohms; 17, 12,000 ohms; 18, 20,000 ohms; 19, 15,000 ohms; 21, 22,000 ohms; 23, 15,000 ohms; 29, 50,000 ohms; 32, 10,000 ohms. Vacuum tubes 20 and 22 may be 6J5's. A twin type of vacuum tube functioning as two amplifiers in a single envelope may be substituted for vacuum tubes 20 and 22. 32 may be a 6J5 connected to function as a diode rectifier. The microammeter 30 may have a range of from zero to 50 microamperes. Any sensitive moving coil type of instrument may be used.

The skin-contacting electrodes 28 may be made of woven metallic fabric formed into the approximate shape of natural sponges and having characteristics of resiliency and compressibility. The electrodes 28 may be applied to the subject by having him clasp them in his hands. One electrode may be retained against the inside of the palm of one hand by means of a U-shaped clamp 40. Flexible conductors 26 are attached to terminal posts 24 and 25. Resistances 29 and 18 are adjusted until a reading is obtained somewhere on the low-current area of the indicating scale of the microammeter 30. Psychoanalysis or psychotherapy may now proceed. Surges of the pointer of the microammeter toward higher current readings on the indicating scale signify relatively rising degrees of emotion or of nervous tension in the subject to which the electrodes 28 are attached.

Variations in ohmic resistance between the skin-contacting electrodes 28 cause variations of electrical potential to appear at the terminals of the indicating microammeter, 30.

The flow of current through 30 is unidirectional and irreversible, because of the action of the rectifying element 32 connected in series with the indicating instrument. If the subject who is undergoing examination or therapy lets go of one of the skin-contacting electrodes, the resulting reversed potentials that would otherwise instantly appear at the terminals of the microammeter are blocked by the high reverse-current resistance of the rectifying vacuum tube 32, and the pointer of the indicating instrument moves smoothly to zero. The terminals of the microammeter 30 are shunted by an adjustable resistance 31, which acts as a damping circuit and at the same time operates as a sensitivity control.

The invention functions in the following novel manner: Firstly, it utilizes the psychogalvanic reflex level, or ohmic skin and body resistance value of the subject. Secondly, upon the flow of current through the indicating microammeter related to the subject's psychogalvanic reflex level I have superimposed a rapidly varying additional value of rectified and unidirectional current which is obtained through the use of one or more resilient and compressible electrodes grasped by the fingers of the subject. The use of these resilient and compressible electrodes enables me, in effect, to translate the delicate and ordinarily imperceptible tensing and relaxing of the muscular structure of the subject's arms and hands into special additional fluctuations of resistance value in the subject's skin and body circuit, and thereby to obtain a new means for varying the potentials appearing at the grid elements of the amplifier input circuit. The amplified fluctuating values of potential caused by this means to appear in the plate circuits of the vacuum tube bridge are converted by the rectifying element 32 into varying values of unidirectional current at the terminals of the direct-current microammeter 30.

The invention thus takes advantage simultaneously of a plurality of reflexes of the human physical and nervous structure; firstly, the psychogalvanometric reflex involving the sweat glands of the skin, and, secondly, muscular reflexes involving slight variations of muscular tension in the arms, hands, and fingers, related to impulses registering, sometimes with considerable rapidity, in the subject's nervous structure. The utilization of the above-described dual re-

flex principle, combined with the use of a current rectifying element in series with a sensitive direct-current indicating instrument, results in an instrument which functions at such a high degree of rapidity and sensitivity that the subject can rarely, if ever, inhibit the registration of accurate and adequate responses during analysis or therapy.

A number of variations in the manner of attaching the electrodes to the subject are possible. An electrode may be grasped in one hand and the second electrode may be applied to some other part of the body. Systemic arrangements comprising a plurality of negative electrodes connected in parallel, or a plurality of positive electrodes in parallel, or both, may be used. The instrument functions effectively with one resilient and compressible electrode and one non-resilient electrode. If this combination of electrodes is used, the resilient electrode may be placed in the subject's right hand, and the non-resilient electrode in the subject's left hand, in the case of a right-handed subject, or oppositely in the case of a left-handed subject.

It is immaterial whether the rectifier tube 32 is connected between the plate element of vacuum tube 22 and the microammeter 30, or between the plate element of vacuum tube 20 and the microammeter, as long as the polarity requirements of the rectifying device are observed.

The registrations observed on the scale of the indicating microammeter are rapid, sharp, and highly informative to the professional psychoanalyst or psychotherapist. The instrument facilitates both diagnosis and therapy. It detects the presence of even a slight degree of narcotization. It has a decisive effect on the prospective patient, as he may be permitted to observe actual registrations of his own non-normal responses to interrogative data. One of the outstanding advantages of the invention is that it insures against an unconscious misvaluation of factors in a case that might result from some personal psychic trauma in the history of the psychotherapist himself. The instrument discloses resentment or resistance in a patient toward therapy or especially toward the practitioner, resulting from something done or said to the patient by the therapist. This consequently results in raising the level of rapport and communication between the patient and the therapist to a level rarely obtained by any other means.

The instrument is convenient to operate. A lever attached to the adjustable resistance 29 reads on a numbered scale and indicates the general emotional and nervous tone-level of the patient. The numeration on this scale may be arbitrary, rather than ohmic. Adjustable resistance 18 functions as an expander of the over-all ohmic range of the instrument. Adjustable resistance 32 controls the sensitivity of the instrument.

Quiescent readings on the indicating scales of the instrument reflect resistance values prevailing in the patient's skin and body circuit and are related in some degree to the nervous condition of the patient. Such readings should be viewed in the light of the general experience and judgment of the therapist. Dynamic fluctuations of the current flowing through the indicating microammeter and rectifying element, however, considered in a time-sequence sense, are highly significant.

I claim:

1. A bio-electronic instrument which registers



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the varying degrees of tension and emotion that may exist in the general physical and nervous structure of a person undergoing any kind of psychoanalysis or psychotherapy, comprising two or more skin-contacting electrodes, means for establishing a difference of electrical potential between the said electrodes, two amplifying vacuum tubes, means for connecting the grid element of one of the said vacuum tubes to one of the aforesaid skin-contacting electrodes, the plate element of the said vacuum tube being connected to the positive terminal of a moving-coil type of current-indicating instrument, the negative terminal of the said current-indicating instrument being connected to the anodic terminal of a current-rectifying element, the cathodic terminal of the said current-rectifying element being connected to the plate element of the second amplifying vacuum tube, means for establishing a biasing potential at the grid of the said second vacuum tube, means for applying electrical operating potentials between the plate and cathode elements of both of the above-mentioned vacuum tubes, means for adjusting the values of one or more of the resistance elements associated with the above-mentioned vacuum tubes so that variations in ohmic resistance occurring between the above-described skin-contacting electrodes are registered by the aforesaid moving-coil indicating instrument.

2. A bio-electronic instrument which registers the varying degrees of tension and emotion that may exist in the general physical and nervous structure of a person undergoing any kind of psychoanalysis or psychotherapy, comprising two or more skin-contacting electrodes, one or more of the said skin-contacting electrodes being resilient and compressible, means for establishing a difference of electrical potential between the said electrodes, two amplifying vacuum tubes, means for connecting the grid element of one of the said vacuum tubes to one of the aforesaid skin-contacting electrodes, the plate element of the said vacuum tube being connected to the anodic terminal of a current-rectifying element, the cathodic terminal of the said current-rectifying element being connected to the positive terminal of a current-indicating instrument, the negative terminal of the said current-indicating instrument being connected to the plate element of the second amplifying vacuum tube, means for establishing a biasing potential at the grid of the said second vacuum tube, means for applying electrical operating potentials between the plate and cathode elements of both of the above-mentioned vacuum tubes, means for adjusting the values of one or more of the resistance elements associated with the above-mentioned vacuum tubes so that variations in ohmic resistance occurring between the above-described skin-contacting electrodes are registered by the aforesaid moving-coil indicating instrument.

3. A bio-electronic instrument which registers the varying degrees of tension and emotion that may exist in the general physical and nervous structure of a person undergoing any kind of psychoanalysis or psychotherapy, comprising two or more skin-contacting electrodes, means for establishing a difference of electrical potential between the said electrodes, two amplifying vacuum tubes, means for connecting the grid element of one of the said vacuum tubes to one of the aforesaid skin-contacting electrodes, the plate element of the aforesaid vacuum tube being connected to the anodic terminal of a current-

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rectifying element, the cathodic terminal of the said current-rectifying element being connected to the positive terminal of a moving-coil type of current-indicating instrument, the negative terminal of the said current-indicating instrument being connected to the plate element of the second amplifying vacuum tube, means for establishing a biasing potential at the grid of the said second vacuum tube, means for applying electrical operating potentials between the plate and cathode elements of both of the above-mentioned vacuum tubes, means for adjusting the values of one or more of the resistance elements associated with the above-mentioned vacuum tubes so that variations in ohmic resistance occurring between the above-described skin-contacting electrodes are registered by the aforesaid moving-coil indicating instrument.

4. A bio-electronic instrument which registers the varying degrees of tension and emotion that may exist in the general physical and nervous structure of a person undergoing any kind of psychoanalysis or psychotherapy, comprising two or more skin-contacting electrodes, one or more of the said skin-contacting electrodes being resilient and compressible, means for establishing a difference of electrical potential between the said skin-contacting electrodes, two amplifying vacuum tubes, means for connecting the grid element of one of the said vacuum tubes to one of the aforesaid skin-contacting electrodes, the plate element of the said vacuum tube being connected to the anodic terminal of a current-rectifying element, the cathodic terminal of the said current-rectifying element being connected to the plate element of the second amplifying vacuum tube, means for establishing a biasing potential at the grid of the said second vacuum tube, means for applying electrical operating potentials between the plate and cathode elements of both of the above-mentioned vacuum tubes, means for adjusting the values of one or more of the resistance elements associated with the above-mentioned vacuum tubes so that variations in ohmic resistance occurring between the above-described skin-contacting electrodes are registered by the aforesaid moving-coil indicating instrument.

5. A bio-electronic instrument which registers the varying degrees of tension and emotion that may exist in the general physical and nervous structure of a person undergoing psychoanalysis or psychotherapy, comprising two or more skin-contacting electrodes, means for establishing a difference of electrical potential between the said electrodes, a twin type of vacuum tube functioning as an amplifier, means for connecting one of the grid elements of the said vacuum tube to one of the aforesaid skin-contacting electrodes, the plate element associated with the said grid element being connected to the positive terminal of a moving-coil type of current-indicating instrument, the negative terminal of the said current-indicating instrument being connected to the anodic terminal of a current-rectifying element, the cathodic terminal of the said current-rectifying element being connected to the plate element of the second section of the aforesaid twin type vacuum tube, means for establishing a biasing potential at the grid of the said second section of the aforesaid twin type vacuum tube, means for applying electrical operating potentials between the plate elements and the cathode elements of the above-mentioned vacuum tube, means for adjusting the values of one or more of the resistance elements associated with the

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above-mentioned vacuum tube so that variations in ohmic resistance occurring between the above-described skin-contacting electrodes are registered by the aforesaid moving-coil current-indicating instrument.

6. A bio-electronic instrument which registers the varying degrees of tension and emotion that may exist in the general physical and nervous structure of a person undergoing psychoanalysis or psychotherapy, comprising two or more skin-contacting electrodes, one or more of the said electrodes being resilient and compressible, means for establishing a difference of electrical potential between the said electrodes, a twin type of vacuum tube functioning as an amplifier, means for connecting one of the grid elements of the said vacuum tube to one of the aforesaid skin-contacting electrodes, the plate element associated with the said grid element being connected to the positive terminal of a current-indicating instrument, the negative terminal of the said current-indicating instrument being connected to the anodic terminal of a current-rectifying element, the cathodic terminal of the said current-rectifying element being connected to the plate element of the second section of the aforesaid twin type vacuum tube, means for establishing a biasing potential at the grid of the said second section of the aforesaid twin type vacuum tube, means for applying electrical operating potentials between the plate elements and the cathode elements of the above-mentioned vacuum tube, means for adjusting the values of one or more of the resistance elements associated with the above-mentioned vacuum tube, so that variations in ohmic resistance occurring between the above-described skin-contacting electrodes are registered by the aforesaid moving-coil current-indicating instrument.

7. A bio-electronic instrument which registers the varying degrees of tension and emotion that may exist in the general physical and nervous structure of a person undergoing psychoanalysis or psychotherapy, comprising two or more skin-contacting electrodes, means for establishing a difference of electrical potential between the said electrodes, a twin type of vacuum tube functioning as an amplifier, means for connecting one of the grid elements of the said vacuum tube to one of the aforesaid skin-contacting electrodes, the plate element associated with the said grid element being connected to the anodic terminal of a current-rectifying element, the cathodic terminal of the said current-rectifying element being connected to the positive terminal of a moving-coil type of current-indicating instrument, the negative terminal of the said current-indicating instrument being connected to the

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plate element of the second section of the aforesaid twin type vacuum tube, means for establishing a biasing potential at the grid of the said second section of the aforesaid twin type vacuum tube, means for applying electrical operating potentials between the plate and cathode elements of the above-mentioned vacuum tube, means for adjusting the values of one or more of the resistance elements associated with the above-mentioned vacuum tube so that variations in ohmic resistance occurring between the above-described skin-contacting electrodes are registered by the aforesaid moving-coil current-indicating instrument.

8. A bio-electronic instrument which registers the varying degrees of tension and emotion that may exist in the general physical and nervous structure of a person undergoing psychoanalysis or psychotherapy, comprising two or more skin-contacting electrodes, one of the said electrodes being resilient and compressible, means for establishing a difference of electrical potential between the said electrodes, a twin type of vacuum tube functioning as an amplifier, means for connecting one of the grid elements of the said vacuum tube to one of the aforesaid skin-contacting electrodes, the plate element associated with the said grid element being connected to the anodic terminal of a current-rectifying element, the cathodic terminal of the said current-rectifying element being connected to the positive terminal of a current-indicating instrument, the negative terminal of the said current-indicating instrument being connected to the plate element of the second section of the aforesaid twin type vacuum tube, means for establishing a biasing potential at the grid of the said second section of the aforesaid twin type vacuum tube, means for applying electrical operating potentials between the plate and cathode elements of the above-mentioned vacuum tube, means for adjusting the values of one or more of the resistance elements associated with the above-mentioned vacuum tube so that variations in ohmic resistance occurring between the above-described skin-contacting electrodes are registered by the aforesaid moving-coil current-indicating instrument.

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Number	Name	Date
2,535,249	Wilhelm	Dec. 26, 1950

##### FOREIGN PATENTS

Number	Country	Date
568,676	Great Britain	Apr. 16, 1945

Dec. 26, 1950

P. L. WILHELM ET AL

2,535,249

ELECTRIC PSYCHOMETER

Filed Feb. 26, 1948

2 Sheets-Sheet 1

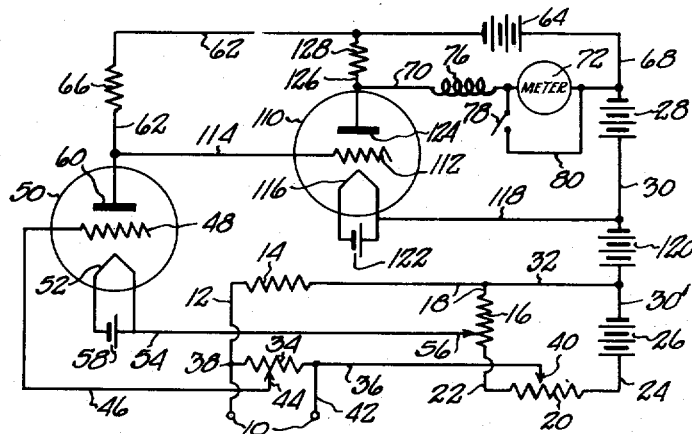


FIG. 3.

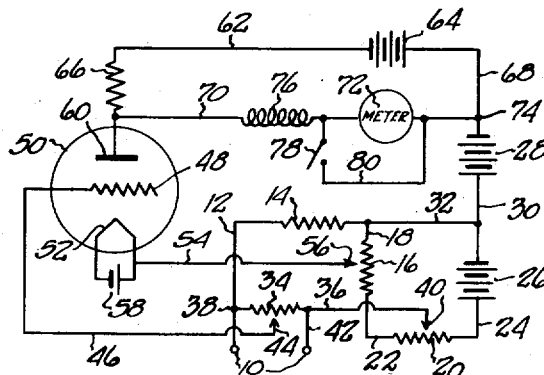


FIG. 2.

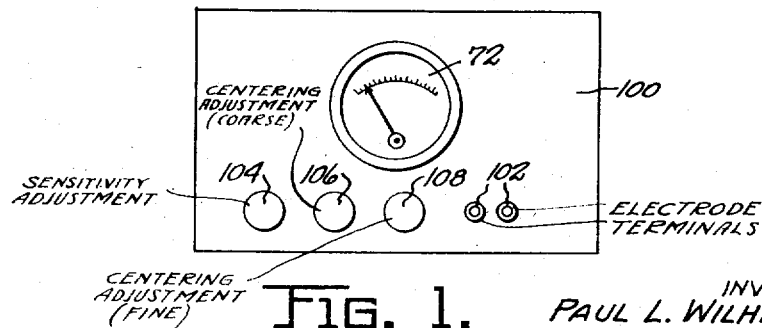


FIG. 1.

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ATTORNEYS

Dec. 26, 1950

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2,535,249

ELECTRIC PSYCHOMETER

Filed Feb. 26, 1948

2 Sheets-Sheet 2

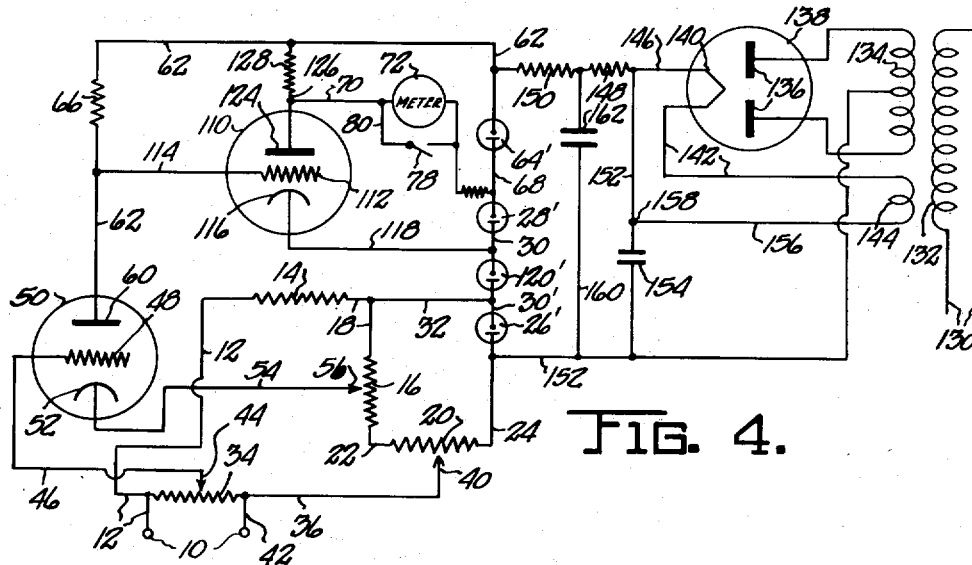


FIG. 4.

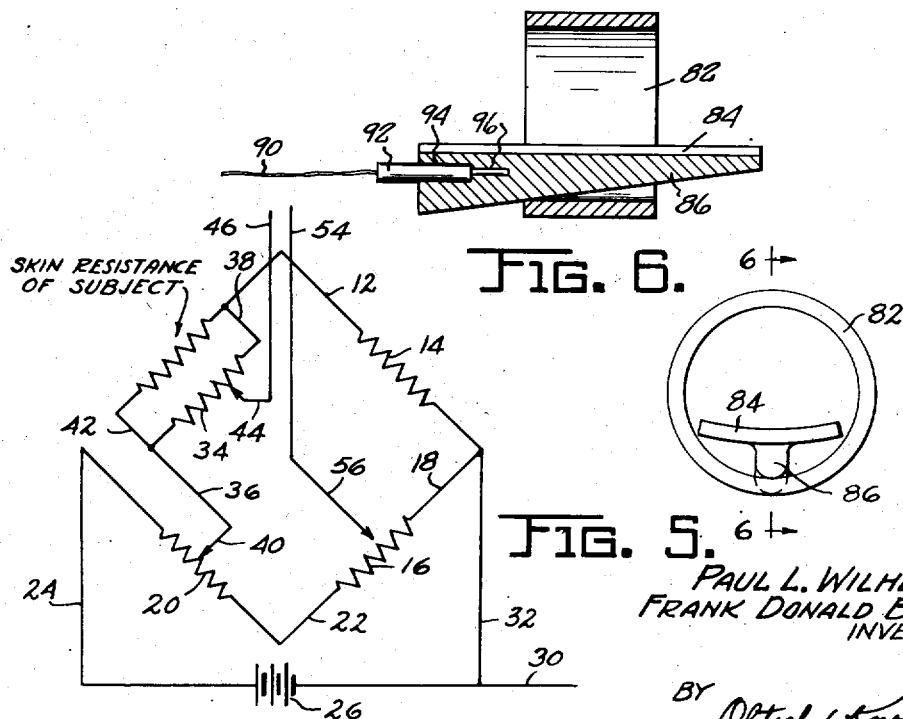


FIG. 6.

FIG. 5.

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FIG. 7

## UNITED STATES PATENT OFFICE

2,535,249

## ELECTRIC PSYCHOMETER

Paul L. Wilhelm, Michigan Township, and Frank  
Donald Burns, Michigan City, Ind.

Application February 26, 1948, Serial No. 11,264

9 Claims. (Cl. 128—2.1)

1

This invention relates to improvements in electric psychometers, sometimes known as lie detectors. The present device utilizes the phenomenon that the resistance of the skin of an individual changes with an emotional change in the human body. We are aware that devices for detecting dishonest from truthful statements of an individual have been provided. These devices, to the best of our knowledge, usually have responded to cardiac and pneumatory reaction of an individual. Such prior devices, while effective for their intended purpose, have been subject to various disadvantages and limitations. Among such disadvantages have been the high cost thereof, the delicate construction thereof, and the large size and heavy weight thereof which has tended to preclude desired portability. Other disadvantages of previous devices have been that they have not been adjustable as to sensitivity according to the personal reactions of different individuals in most cases, and, further, that the attachments to the body of the individual necessary for their use have produced discomfort of the subject and thus required that the tests of the subject by use of the device be limited as to time.

The primary objects of this invention are to provide a device of this character which is comparatively inexpensive so that it may be available for use by law enforcement and other agencies having limited funds, which is light in weight and portable so that it may readily be transported from place to place, and which is rugged in construction to resist damage incident to use thereof and to transportation thereof.

A further object is to provide a device of this character with means for adjusting the sensitivity of response thereof so that the variations in the reactions of different individuals may be compensated and accurate readings secured for all subjects, and which is further provided with convenient means for calibrating the device.

A further object is to provide a device of this character which may use a sensitive but comparatively rugged measuring element, such as a milliammeter, and which includes means to protect the measuring device automatically in the event that the current being measured exceeds the range of the instrument during use.

A further object is to provide a device of this character with means adapted to be worn by the subject for detecting variations in skin resistance, which are of novel construction, which may be applied and removed easily and quickly, and which may be worn for extended periods of

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time to facilitate extended questioning of the subject without discomfort to the subject.

A further object is to provide a device of this character which can be used by individuals having little familiarity with electrical apparatus without requiring extensive personal instructions to such individual, and which is constructed from standard electrical parts readily available at firms dealing in electrical and radio equipment.

A further object is to provide a device of this character which will not be damaged by accidental energization thereof over long periods of time and in which no danger exists that the subject will be harmed or injured by electrical shock.

Other objects will be apparent from the following specification.

In the drawing:

Fig. 1 is a front elevation of the instrument mounted in a case and provided with indicating means and control means.

Fig. 2 is a circuit powered by batteries, embodying the invention and utilizing one stage of amplification.

Fig. 3 is a circuit illustrating a modified embodiment of the invention utilizing two stages of amplification.

Fig. 4 is a circuit adapted for operation by alternating current.

Fig. 5 is an end view of the skin contacting electrode used in the device.

Fig. 6 is a longitudinal sectional view taken on line 6—6 of Fig. 5.

Fig. 7 is a circuit illustrating the manner in which the various elements of applicants' device are connected, to provide a modified Wheatstone bridge.

Referring to the drawing, and particularly to Fig. 2 thereof which illustrates one embodiment of the invention, the numeral 10 designates the terminals to which the skin engaging device, such as the device shown in Figs. 5 and 6, is adapted to be connected. One of these terminals 10 is connected by a lead 12 with a resistor 14, and the resistor 14 is connected in series with a resistor 16 by means of a lead 18. The resistor 16 in turn is connected with a resistor 20 by means of a lead 22. The resistor 20 is connected by a lead 24 in series with a battery 26. A second battery 28 is connected in series with the battery 26 by a lead 30, and a lead 32 branches from the lead 30 between the two batteries 26 and 28 and is tapped to the conductor or lead 18 between the resistors 14 and 16. A resistor 34 is interposed in a lead 36 tapped to the lead 12 at 38. The lead 36 will

include a flexible portion which terminates in a slider member 40 adapted to engage the resistance 20 and cooperating therewith to provide a variable resistor for zero adjustment or centering. The second terminal 10 is tapped to the lead 36 between the resistance 34 and the terminal 40 by a lead 42.

A slider 44 for sensitivity adjustment cooperates with the resistance 34 and is connected by a lead 46 with the grid 48 of a signal amplifying electron emission tube 50. The cathode 52 of the tube 50 is connected by a lead 54 with a second zero adjusting or centering slider element 56 cooperating with the resistor 16. In the preferred form the circuit to the cathode will include a battery 58.

The plate 60 of the tube 50 is connected by a lead 62 with a plate battery 64, there preferably being a fixed resistor 66 connected in the lead 62 between the tube and the battery 64. The lead 68 connects the battery 64 in series with the battery 28. A lead 70 is tapped from the lead 62 at the terminal of the plate 60 and between the plate 60 and the resistor 66. This lead 70 serves to connect a measuring instrument, such as a milliammeter 72 or a recorder, in the circuit in parallel to the resistor 66 and the battery 64 with its opposite end being tapped at 74 to the lead 68. The coil 76 of a relay is interposed in the lead 70 and the armature 78 of the relay constitutes or controls a switch interposed in a shunt circuit 80 in parallel with the measuring element 72.

The elements which respond to the skin resistance of the subject are best illustrated in Figs. 5 and 6 and comprise two parts. One part is preferably in the form of a ring or short tube 82 formed of conductive material, the diameter of whose bore is slightly greater than the inner peripheral diameter of a finger ring of the largest size offered by jewelers. The other part comprises an elongated conductive metallic plate 84 of concave-convex form in transverse configuration and provided at the center of its convex face with a longitudinal integral rib 86 of tapered form. A flexible electrical lead 90 is electrically connected with a plug 92 which fits within a socket formed in the electrode 84, 86. In the preferred form the socket will be constructed as illustrated in Fig. 6 with a large diameter portion 94 thereof adapted to receive the large portion of a plug 92 and with a small diameter inner socket portion 96 slightly eccentric with respect to the socket portion 94 and adapted to receive a reduced terminal projection of the plug 92.

The device is adapted to be mounted in a housing or casing 100, as best illustrated in Fig. 1. This housing will mount sockets 102 adapted to detachably receive plugs (not shown) which are mounted upon the lead 90 to the electrodes. The sockets 102 will constitute the terminals 10 illustrated in the circuit in Fig. 2. The casing 100 will mount the measuring member or milliammeter 72 in its front wall to be readily visible by the operator. A plurality of knobs 104, 106 and 108 will be mounted upon the casing 100. These knobs will be connected respectively with the slider 44, the slider 56 and the slider 40, to control the adjustment of said sliders. The front panel mounting of these knobs permits their use while viewing the meter 72 to facilitate the adjustment and control of the operating circuit.

Two finger electrodes are employed, being

mounted upon different fingers and each of which has only one lead 90 connected thereto, the circuit being completed through the skin of the subject. It will be apparent that the finger electrodes can be used very simply by sliding the retainer ring 82 over the finger of a subject and then sliding the elongated electrode 84 within that retainer ring to a position in which it engages the skin of the user with a positive but comfortable electrical contact.

It will be observed that the circuit is essentially a Wheatstone bridge circuit in which the resistors 14, 16 and 20 constitute three of the legs of the circuit and the electrical resistance of the skin of the subject forms the fourth resistor in the circuit. The resistor 34 is connected in parallel with the resistance formed by the skin of the subject. The output of the bridge is conducted through the leads 46 and 54 to the electronic tube 50 by which the current is amplified to a value sufficient to energize the measuring device 72. The current values in this instance can be kept at a very low level, thus insuring against electrical shock or injury to the subject and yet are sufficiently high to permit the use of a fairly rugged type of electrical instrument, such as a milliammeter, as the measuring means. In this connection, the amplification by the electron tube is sufficient to raise the signal strength for actuating the meter 72 from a very small value to which only a galvanometer would be responsive to the higher value, thus making it possible to use the comparatively rugged milliammeter in place of a simple galvanometer.

One of the outstanding advantages of the device is that it may be adjusted to compensate for differences in the skin resistance of different subjects by varying the position of the slider 44 upon the resistance 34. Thus in instances where the skin resistance of two subjects vary, the slider can be adjusted during initial preliminary testing with each subject to establish the conditions required for use as to that subject, thus setting up the instrument to give, upon the metering element 72, indications which are equal in amplitude to those of a subject whose skin resistance is at a substantially different electrical value.

A second important feature of this device is the provision of means for centering or balancing the instrument. Thus, whenever any adjustment of the sensitivity slider 44 is made, it will affect the balance of the bridge and the zero positioning of the pointer of the milliammeter 72. The sliders 40 and 56 constitute these centering means. One thereof may be provided for relatively coarse adjustment, and the second thereof may be constructed for relatively fine adjustment. Thus by the manipulation of the proper ones of the knobs 106 and 108 controlling the sliders 56 and 40, the indicator needle can quickly be restored to a zero position.

Another important advantage of the device is the provision of the relay 76, 78 for controlling the shunt circuit 80. This relay can be so constructed that in the event the current flow through the line 70 to the meter 72 reaches or exceeds the maximum current which the instrument will carry, the relay will operate to close the normally open shunt circuit 80, thereby preventing the possibility that the meter 72 will be subjected to any damaging current flow condition.

The ability of the device to be operated by batteries, the simplicity of the skin contacting

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electrodes, the simplicity of the adjustments and of the operating circuit, all make for compactness and light weight of a unit, rendering it both portable and rugged as well as inexpensive in cost.

In the use of the device two electrode units, as illustrated in Figs. 5 and 6, are fastened on two fingers of the subject, being connected in the circuit as the sockets 102. A small amount of electric current is passed through the body while the resistance of the body is balanced by the adjustable resistor 44 in the bridge circuit. In other words, after the individual has been placed at rest after the electrodes have been attached to his fingers, the rheostat 44 is adjusted by manipulation of the proper one of the knobs 104, 106, 108, followed by adjustment of the other knobs which serve to control the rheostats 40 and 56 to accurately center the position of the needle of the meter 72. The latter adjustments are preferably performed by moving said sliders to a zero position and then progressively shifting them until the desired reading is indicated upon the meter 72, that is, a centered reading. The sensitivity setting can then be checked by having the subject take a deep breath which will produce a certain activation of the meter under normal conditions. If the meter operation exceeds or falls below this normal, a change in the setting of the slider 44 may be made, followed by changes in the setting of the sliders 40 and 56 for centering purposes, and the sensitivity can then be checked again.

In testing a subject it is desirable that a fixed set of questions which can be answered "Yes" or "No" should be prepared in advance, certain of which relate to nonpertinent matters, and notes can be made of the readings of the meter 72 in conjunction with the answering of such nonpertinent questions. Such reading can be utilized to establish the normal reaction of the subject to questioning. Several of the questions interspersed among the list to be asked will pertain to the subject matter of the investigation. It is desirable that this list of questions be asked of the subject more than once but preferably not more than three times, and notes should be taken of the readings applying to each question on each occurrence of its asking. It is important that sufficient time be allowed between answers to permit the needle or indicator of the measuring unit 72 to return to a rest position normal to the subject before another question is asked. During the questioning the subject should remain quiet and relaxed, and his attention should not be diverted from the questions by any external means, and preferably not by any sound or noise. The results of the readings must be interpreted from experience and any possibilities that an abnormal reaction has been caused by any condition, except an untruthful answer, must be ascertained. Thus if physical movement has occurred, or if interference has occurred, or if it appears that the subject is frightened by the machine, or if it appears that the question asked may be creating a mental association in the mind of the subject with a fact situation different from that being investigated, such conditions may account for abnormality of the response or reaction of the subject. In the interpretation of the readings it must also be borne in mind that there is no set of abnormal reactions to indicate that a lie has been told, and the operator through experience can readily

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judge when a lie has been told, according to the difference between a normal reaction and an abnormal reaction caused by lying. As a general rule, however, it will be found that, where the subject lies, the abnormal reaction shown will be at least twice as much as the normal reaction on the same test. In other words, if normal reaction of the subject gives meter readings from zero to three, then meter readings of six or more tend to indicate that a lie has been told.

The circuit shown in Fig. 3 differs from the circuit shown in Fig. 2 essentially by the fact that two stages of amplification are provided instead of the single stage of amplification as shown in Fig. 2. The parts of Fig. 3 which are similar to the parts of Fig. 2 bear the same reference numerals. The second stage of amplification is provided by an electron tube 110 whose grid 112 is connected by a lead 114 tapped from the lead 62 at a point between the plate 60 of the first tube 50 and the resistor 66 in lead 62. The cathode 116 of the tube 110 is connected by a lead 118 with lead 30 between the battery 28 and a battery 120. The lead 32 in this circuit is tapped with the lead 30' at a point between the battery 120 and the battery 26. The cathode circuit includes the battery 122 similar to the battery 58 used with the electron tube 60. The plate 124 of the tube 110 is connected by a lead 126 with the lead 62 between the resistance 66 and the battery 64 in the lead 62. The lead 126 has a resistance 128 interposed therein. The lead 70 is connected with the lead 126 between the resistance 128 and the tube plate 124 and extends in parallel with the battery 64 having its opposite end connected with the lead 68 between the batteries 64 and 28. The relay 76, 78 is provided in conjunction with the lead 70 and the shunt lead 80 in the same manner as in the Fig. 2 embodiment, said shunt lead 80 be adapted for connection across the opposite terminals of the measuring meter 72. This embodiment of the invention possesses all of the advantages and is constructed to operate in the same manner as the device shown in Fig. 2, differing therefrom solely with respect to the number of stages of amplification.

Fig. 4 illustrates a device which is adapted to be actuated from an alternating current source with which the leads 130 are connected. The power circuit 130 has the primary coil 132 of a transformer interposed therein. The transformer may be of any suitable type and preferably has two secondary coils. One secondary coil 134 has its opposite ends connected with the two anodes 136 of a full wave rectifier tube 138. The cathode 140 of the rectifier tube 138 is connected by a lead 142 with a second secondary coil 144 of the transformer. The other terminal of the cathode is connected by a lead 146 with the lead 62 of the psychometer circuit and has resistances 148 and 150 connected or interposed therein in series relation. A lead 152 is tapped from the lead 146 between the cathode 140 and the resistance 148 and has a filtering condenser 154 interposed therein. The lead 152 is connected with the lead 24 of the psychometer circuit. The second terminal of the secondary coil 144 is connected by a lead 156 with the lead 152 to which it is tapped at 158 between the cathode 140 and the filtering condenser 154. A lead 160 is tapped to the lead 146 between the resistances 148 and 150 and is tapped at its opposite end to the lead 152 between the condenser 154 and the point of connection of the lead 152 with the psychometer



circuit. The lead 160 has a filtering condenser 162 interposed therein.

In this embodiment of the invention wherein the psychometer circuit is substantially the same as that shown in Fig. 3 involving the use of two stages of amplification provided by the tubes 50 and 110, respectively, it will be observed that the various batteries utilized in the Figs. 2 and 3 devices are omitted, and in their place are used voltage regulator tubes. Thus voltage regulator tubes 26', 120', 28' and 64' are used in Fig. 4 in place of the batteries 26, 120, 28 and 64, respectively, utilized in the embodiment illustrated in Fig. 3.

The operation of this device is the same as the operation described above with the exception that the device is operated by alternating current and therefore must be connected with a source of power and have built into it, in addition to the basic psychometer circuit, the transformer 132, 134, 144, the full wave rectifier 138 and the other supply circuit elements including the filtering condensers 154 and 162. However, these changes do not substantially increase the weight, size or cost of the unit and do not detract from the accomplishment of the advantages hereinabove referred to by the device.

While the preferred embodiment of the invention has been illustrated and described herein, it will be understood that changes may be made therein within the scope of the appended claims without departing from the spirit of the invention as defined in the claims in this application.

**We claim:**

1. An electric psychometer comprising an electric circuit, a Wheatstone bridge connected in said circuit and including input and output leads and a plurality of resistors forming legs of said bridge, electrode means adapted for engagement with the skin of a person and so connected with said bridge that the resistance of the skin forms one leg of said bridge, an amplifier in said circuit and connected with the output leads of said bridge, and a meter in said circuit for measuring the output of said amplifier, a normally open shunt connected in said circuit around said meter, and a relay responsive to the flow of current to said meter and adapted to close said shunt when current flow reaches a predetermined value.

2. An electric psychometer comprising an electric circuit, a Wheatstone bridge connected in said circuit and including input and output leads and a plurality of resistors forming legs of said bridge, electrode means adapted for engagement with the skin of a person and so connected with said bridge that the resistance of the skin forms one leg of said bridge, an amplifier in said circuit and connected with the output leads of said bridge, and a meter in said circuit for measuring the output of said amplifier, and means responsive to a predetermined electrical condition for shunting said meter.

3. An electric psychometer comprising an electric circuit, a Wheatstone bridge connected in said circuit and including input and output leads and a plurality of resistors forming legs of said bridge, electrode means adapted for engagement with the skin of a person and directly connected with said bridge so that the resistance of the skin forms one leg of said bridge and said bridge is instantaneously responsive to variations in skin resistance, an amplifier in said circuit and connected with the output leads of said bridge, and a meter in said circuit for measuring the output

of said amplifier, one of said resistors being a variable balancing resistor and including a slider connected to one of said output leads for centering said meter.

4. An electric psychometer comprising an electric circuit, a Wheatstone bridge connected in said circuit and including input and output leads and a plurality of resistors forming legs of said bridge, electrode means adapted for engagement with the skin of a person and directly connected with said bridge so that the resistance of the skin forms one leg of said bridge and said bridge is instantaneously responsive to variations in skin resistance, an amplifier in said circuit and connected with the output leads of said bridge, and a meter in said circuit for measuring the output of said amplifier, said bridge including a variable resistor connected in parallel with said electrode means and having a slider connected to one bridge output lead and adjustable to vary the sensitivity of said bridge.

5. An electric psychometer comprising an electric circuit including energizing means, a plurality of resistors connected in said circuit, electrode means adapted to engage the skin of a person and directly connected in said circuit, said resistors and electrodes cooperating to form a Wheatstone bridge circuit in which the skin of the person constitutes one leg of said Wheatstone bridge, said bridge being instantaneously responsive to variations in skin resistance an amplifier in said circuit for amplifying the output of said Wheatstone bridge, means in said circuit for measuring the output of said amplifier, and means for adjusting said bridge to vary the sensitivity of said circuit.

6. An electric psychometer comprising an electric circuit including energizing means, a plurality of resistors connected in said circuit, electrode means adapted to engage the skin of a person and directly connected in said circuit, said resistors and electrodes cooperating to form a Wheatstone bridge circuit in which the skin of the person constitutes one leg of said Wheatstone bridge, said bridge being instantaneously responsive to variations in skin resistance an amplifier in said circuit for amplifying the output of said Wheatstone bridge, means in said circuit for measuring the output of said amplifier, and means for adjusting said bridge to center said measuring means.

7. An electric psychometer comprising an electric circuit including energizing means, a plurality of resistors connected in said circuit, electrode means adapted to engage the skin of a person and directly connected in said circuit, said resistors and electrodes cooperating to form a Wheatstone bridge circuit in which the skin of the person constitutes one leg of said Wheatstone bridge, said bridge being instantaneously responsive to variations in skin resistance an amplifier in said circuit for amplifying the output of said Wheatstone bridge, means in said circuit for measuring the output of said amplifier, means for adjusting said bridge to vary the sensitivity of said circuit, and means for adjusting said bridge to center said measuring means.

8. In an electric psychometer, a Wheatstone bridge circuit including a pair of input leads and a pair of output leads, a pair of variable resistors having resistance elements connected in series between said input leads and each having a slider, a third variable resistor having a slider and a resistance element, a fixed resistor



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connected at one input lead and in series with the resistance element of the third resistor and with the slider of that one of the first named resistors connected to the other input lead, one output lead being connected to the slider of the other of said first named resistors, the other output lead being connected to the slider of the third resistor.

9. In an electric psychometer, a Wheatstone bridge circuit including a pair of input leads and a pair of output leads, a pair of variable resistors having resistance elements connected in series between said input leads and each having a slider, a third variable resistor having a slider and a resistance element, a fixed resistor connected at one input lead and in series with the resistance element of the third resistor and with the slider of that one of the first named resistors connected to the other input lead, one output lead being connected to the slider of the other of said first named resistors, the other

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output lead being connected to the slider of the third resistor, and electrode means connected to said bridge circuit in parallel to the resistance element of the third resistor, said electrode means being adapted for engagement with the skin of a person whereby the resistance of the skin influences said bridge circuit.

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2,379,955

AMUSEMENT DEVICE FOR REGISTERING EMOTIONS

Filed Sept. 21, 1943

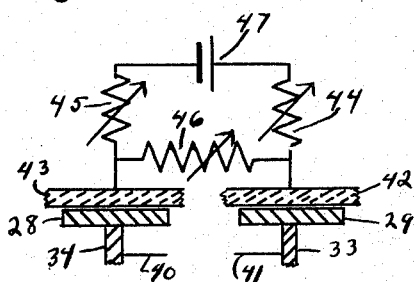
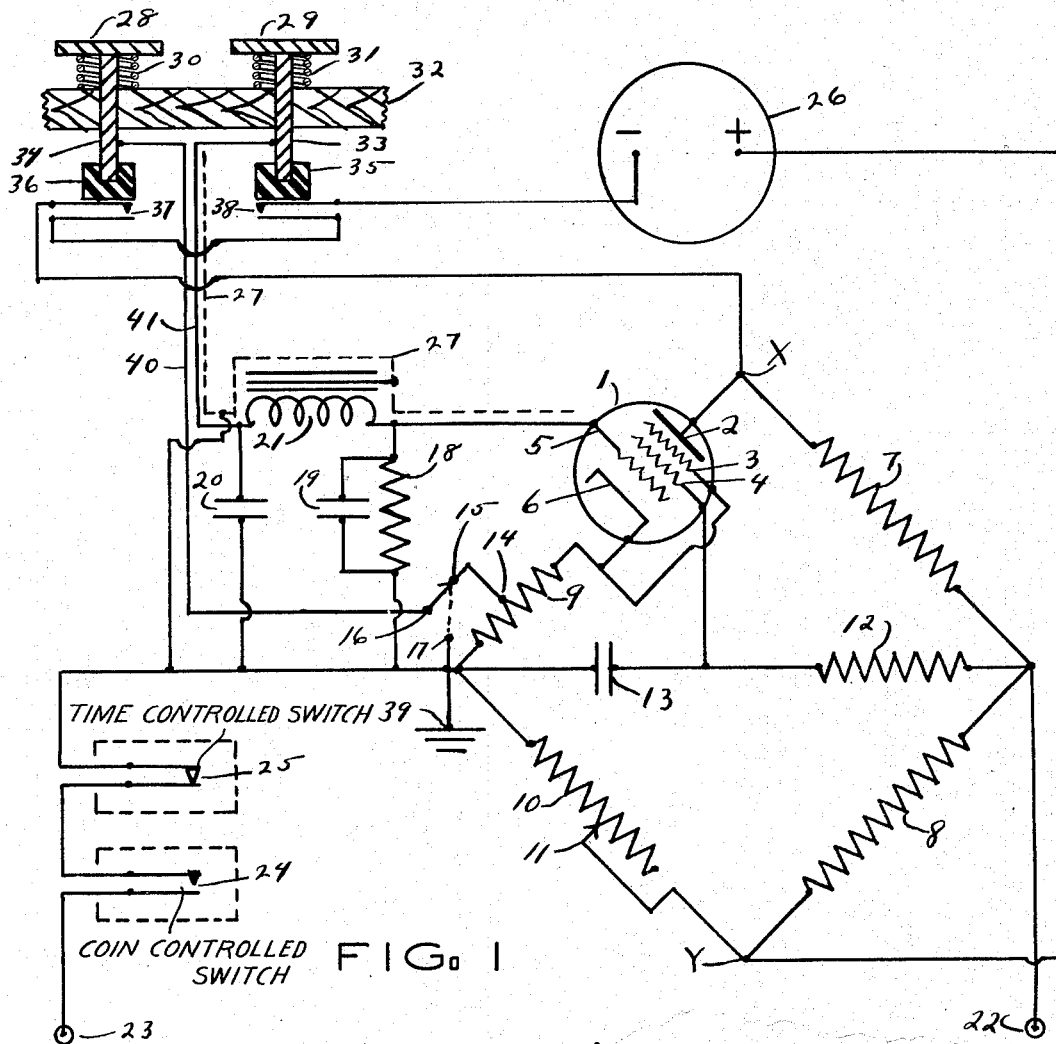


FIG. 2

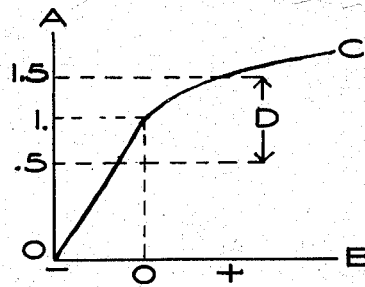


FIG. 3

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## UNITED STATES PATENT OFFICE

2,379,955

AMUSEMENT DEVICE FOR REGISTERING  
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of Illinois

Application September 21, 1943, Serial No. 503,303

4 Claims. (Cl. 128—2.1)

This invention relates to an amusement device for registering the instantaneous emotional state of a player. The operation is based on two very well known biological facts: First, that a voltage differential exists between any two parts of the human anatomy and that under certain circumstances the amplitude of this voltage may be used as an indication of emotional state and, second, the ohmic resistance between any two parts of the human anatomy also varies in accordance with the emotional state.

Referring to part first above, two of the voltages most commonly used for diagnostic purposes are the cardiac voltage, as recorded on the electrocardiograph, and the brain voltage, as recorded on the electroencephalograph, both of these voltages having a wave form which may be described as pulsating direct current.

For the purposes of this invention, the direct current potential existing between the palms of the hand, or between two points on the palm of one hand, may be used as an indication of emotional state of the player. That such a voltage exists between the palms of the hands, or between two points on the palm of one hand, is well known and may be readily confirmed with my sensitive direct current galvanometer. It is not known definitely to what extent this voltage fluctuates with emotional state in a human subject, but numerous measurements confirm that such a relationship does exist, the measured voltage being extremely low during sleep, giving rise to a current of the order of .025 microampere, as measured on a sensitive undamped galvanometer, rising to values as high as 3 microamperes in a subject fully alert or emotionally tense, with values on the order of .05 microampere to .25 microampere in a fully awake but emotionally relaxed subject.

In addition to the discussion of potential difference immediately above, the ohmic resistance also varies inversely as the voltage, this resistance being on the order of several megohms during sleep and falling to a value as low as 10,000 ohms in an emotionally tense subject. It is not definitely known to what extent the instantaneous voltage is related to the instantaneous ohmic resistance but, at least in a general way, such relationship does exist, as confirmed by numerous measurements.

It is not the purpose of the present invention to register the voltage and/or ohmic resistance of a subject or player as a truly scientific measure of emotional state, but rather to register these values for amusement purposes only, but to

so arrange a device that such registration is at least in part on a scientific basis. Numerous devices referred to as "fortune-tellers," "love meters," and "kiss meters" are now on the market, but such devices all work on the law of probability, giving the player a printed answer, the selection of said answer being purely on a law of probability basis. The present invention proposes to give the player a suitable answer on registration means provided, where such answer is at least in part based on physical information obtained from the player.

The objects of this invention are:

First, in an amusement device, to provide a method of registering the degree of emotional tenseness or, inversely, emotional relaxation by means of recording the electrical potential difference between two parts of the player's anatomy.

Second, in an amusement device, to provide a method of registering the degree of emotional tenseness or, inversely, emotional relaxation by recording instantaneous ohmic resistance and the instantaneous electric potential between two parts of the player's anatomy.

Third, in an amusement device, to provide a method of registering the degree of emotional tenseness or, inversely, emotional relaxation of a player by recording both the electric potential and ohmic resistance existing between two parts of the player's anatomy.

From the foregoing description, it may seem to be a relatively simple matter to record the electric potential existing between the palms of a player, or between two points on the palm of a player, or to record the ohmic resistance between such points. This is not the case, as numerous difficulties are encountered in attempting to accurately record either of these two values and these difficulties have been overcome by the present invention.

In recording the electric potential, it is not practical to use a sensitive galvanometer, as such a device would not stand the abuse to which any amusement device in a public place is subject, such sensitive galvanometer being subject to damage by even slight mechanical shock. Furthermore, voltage or current recording instruments with sufficient sensitivity for direct connection to a human subject are too sensitive for use in an amusement device, as it is necessary to allow the deflecting mechanism to come to rest in order to get a reading, and furthermore, such a sensitive recording instrument, even if highly damped, will accurately follow any small voltage or current changes, so that it is impossible for

an average player, unskilled in reading electrical meters, to obtain any satisfactory steady state reading on such a sensitive instrument. Therefore, it is apparent that the electric potential difference existing in the player must be amplified sufficiently that a relatively stable electrical indicating means may be used, such as, for example, a milliammeter. The present invention provides methods and means for smoothing out small changes in potential so that a steady average reading is obtained.

A further difficulty encountered is that when the player voltage is amplified sufficiently to actuate a milliammeter, there is a tendency to pick up and amplify a considerable amount of stray field, from 60 cycle electric light wiring, electric motors, and other apparatus. This stray field strength varies with location but is almost always present, especially in any location such as an amusement arcade, where numerous electrical appliances are in use, and very often the strength of such stray fields may exceed the player potential which is to be measured. That this is so may be easily verified by placing the hands on the input terminals of a sensitive vacuum tube voltmeter; a reading varying from a few tenths of one volt to several volts will be obtained, this reading being dependent on the stray field strengths and not on the body potential of the subject.

A further consideration is that the actual direct current potential existing between the palms of a player may at any given instant be of either polarity and such polarity may instantaneously change. The reason for this is not definitely known but it is obvious that for purposes of an amusement device it is necessary to have a voltage reading in one direction only.

From the foregoing, it is apparent that in order to register the electric potential existing between the palms of a player it is necessary to, first, amplify the voltage sufficiently to actuate an electric indicating mechanism which is mechanically reliable and not subject to vibration. Second, it is necessary to provide means so that an average reading is obtained which does not consistently fluctuate between peaks and valleys of the true voltage, where said average value is the true resultant of such voltage peaks and valleys. Third, it is necessary to provide means for eliminating all stray field pickup, from 60 cycle light lines, etc., without affecting the voltage it is desired to record. Fourth, it is necessary to provide means so that the voltage reading is always in the same direction, to prevent a reverse reading on the registering means.

Where the ohmic resistance is recorded, difficulties are also encountered. If subject resistance is measured by means of an ohmmeter such as is commonly used in laboratory measurement, the reading is falsely low, due to the fact that the current passed by the ohmmeter circuit is sufficiently large to stimulate nerve and/or muscle action potential, which in themselves provide a voltage surge which is added to the voltage flowing in the ohmmeter circuit. This difficulty might be overcome by using a very sensitive recording instrument, but such a sensitive instrument would not be satisfactory in an amusement device, for the same reasons mentioned above. The present invention discloses means of measuring the ohmic resistance of the player by passing a very minute current, on the order of several microamperes, and amplifying the resultant to obtain a reading on an indicating mechanism which is mechanically

stable. When amplifying this small voltage change it is necessary to observe all of the same precautions as noted above in regard to amplifying the electric potential difference of the player.

In the preferred form, this invention measures both the ohmic resistance and the electric potential of the player, in such a manner that these values co-operate to produce a final reading on the registering means provided. This invention will be best understood from a consideration of the following detailed description, in view of the accompanying drawing forming a part of the specification; nevertheless, it is to be understood that the invention is not confined to the disclosure, being susceptible of such changes and modifications as define no material departure from the salient features of the invention as expressed in the appended claims.

In the drawing:

Figure 1 represents schematically an electronic circuit which may be used in the practice of this invention.

Figure 2 schematically represents the player's equivalent circuit.

Figure 3 graphically represents a desirable grid voltage-plate current relationship for the vacuum tube in the schematic circuit of Figure 1.

Referring more particularly to Figure 1, vacuum tube 1 is a high gain pentode representing part of one arm in a bridge circuit, it being understood that 1 may also represent other vacuum tube forms, such as a triode, and also that vacuum tube 1 may represent an amplifier having more than one stage. I have found that a single high gain pentode used in the schematic circuit of Figure 1 provides sufficient voltage gain for the intended purpose, but two or more tubes may be used in a cascade amplifier without departing from the principles disclosed by this invention.

Resistors 7 and 8 are of like value and form two arms of the bridge; a third arm is formed by the resistance between plate 2 and cathode 6 of vacuum tube 1, in series with cathode resistor 9. The fourth arm is formed by variable resistor 10, having a slider 11, resistor 10 and slider 11 being used to balance the bridge.

Suppressor grid 3 of vacuum tube 1 is normally connected to cathode 6, while screen grid 4 is energized through resistor 12 which is bypassed through condenser 13. To the terminal 22 is connected the plus terminal of a source of high voltage, preferably regulated by means of a gas discharge tube or otherwise. Indicating meter 26 is connected between the balanced points X and Y of the bridge, in series with normally open contacts 37 and 38. The negative terminal of the high voltage source is connected to terminal 23, which is connected to common ground 39 in series with normally open contacts 24, which in an amusement device may well represent a coin operated switch, and normally closed contacts 25, which in an amusement device may well represent a time switch so arranged to reopen contacts 24 at a pre-determined time after contacts 24 have been closed by inserting a coin, it being understood that other arrangements may be used in lieu of coin controlled switch 24 and time controlled switch 25; the arrangement shown being merely representative of those arrangements commonly used in coin operated devices.

Control grid 5 of vacuum tube 1 is connected to an external electrode 29, in series with choke coil 21, shielded lead 41 and shaft 33. Choke coil 21 is of the iron core type having a relatively high inductance value, and this choke coil co-

operates with condensers 20 and 19 to form a low-pass filter which offers only ohmic resistance to the passage of direct current voltage, while effectively by-passing all alternating voltage, even where the frequency is on the order of 30 cycles per second. In order to be effective in smoothing out such low frequency, condenser 20 must be of relatively high capacity, preferably of the paper insulated type, having a very low leakage factor. Electrolytic condensers have not been found satisfactory for this purpose, as in effect they provide additional shunt resistance between control grid 5 and common ground 39. Condenser 19 may well be a relatively high capacity mica condenser, which contributes little to filtering low frequency alternating current but effectively by-passes high frequency surges which may be picked up by electrode 29 as a result of opening or closing electric switches in the near vicinity, arcing motor brushes, etc. The shielding of the lead 41, the filter choke 21 and its connecting lead to control grid 5 by the shield 27 prevents these parts from responding to stray fields, and limits the stray field pickup to the electrode 29. The reduction in stray field pickup to the electrode 29, in combination with the filter for by-passing both low and high frequencies, renders the vacuum tube unresponsive to power line surges and to induction at the power line frequency. Resistor 18 acts to normally provide control grid 5 with a bias voltage negative in respect to cathode 6, resistor 18 normally being of relatively high ohmic value, approximating 1 megohm. Cathode resistor 9 is sufficiently high in value so that vacuum tube 1 is operated near plate current cutoff, and under static conditions, with no input voltage to control grid 5, the bridge is balanced by adjusting slide arm 11 of resistor 10 to a value where no current flows between points X and Y of the bridge, at which time indicating meter 26 will register 0, assuming that series contacts 37 and 38 have been closed for purposes of making this adjustment.

Electrodes 28 and 29 are formed of any similar metal. For example, both electrodes 28 and 29 may be circular disks formed of aluminum or any other metal, the only requirement being that both electrodes be of the same kind of metal, it being understood that any desired shape may be given to electrodes 28 and 29; for example, they may be spherical, flat, elliptical, half-round, or any other desired shape, this factor being a function of choice rather than necessity. It is also understood that electrodes 28 and 29, while preferably designed to be contacted by both palms of the player, may be arranged in any convenient manner adjacent to each other so that only one palm of the player rests on both electrodes. The results of either method are the same, except that the actual reading obtained by using both palms is usually somewhat higher than the reading obtained between any two points on the same palm. These electrodes may also be arranged to come in contact with other portions of the anatomy besides the palms. For example, a very satisfactory reading may be obtained between either palm and the forehead. It is believed that the palms offer the most satisfactory points of contact for use in an amusement device, although other points of contact may be used.

Electrode 28 is connected to shaft 34 in any convenient manner, insulating bushing 36 being arranged to close contact 37 when electrode 28 is depressed by the player, coil spring 30 acting to hold electrode 28 in the non-operated position

until depressed by the player. Connection is made to shaft 34 and electrode 28 by lead 40, which in turn is connected to switch arm 16, which may be in contact with either switch point 15 or switch point 17, as desired.

With switch arm 16 contacting point 15, as shown by Figure 1, contact is established with tap 14 on cathode resistor 9. This places a small voltage in series with electrode 28, the player electrode 29 and choke coil 21, so that a less negative potential is placed on control grid 5, the value of such potential being dependent on the ohmic resistance of the player. Tap 14 is so chosen that the maximum current flowing through this series circuit is relatively small, on the order of a few microamperes, below the threshold value where nerve stimulation would occur, which does occur with an ordinary ohmmeter, where current values between several hundred and several thousand microamperes are used. Furthermore, the polarized potential present on electrode 28 acts to polarize the electric potential difference normally present in the player, so that the total operating voltage present on control grid 5 is always less negative than the static voltage control grid 5. The effect of this is that the normal negative grid bias of control grid 5 is made less negative, with a resultant rise in plate current, this rise in plate current increasing the voltage drop across resistor 7, thereby unbalancing the bridge and permitting a current to flow through indicating meter 26, the value of this current being dependent both on the electric potential difference of the player and the ohmic resistance of the player.

The structure of electrode 29 is similar to that of electrode 28 previously described, except that connecting lead 41 is shielded by grounded shield 27, the entire arrangement being such that both electrodes must be depressed by the player in order to establish the circuit for indicating meter 26. While contacts 37 and 38 are not absolutely essential to the operation of the device, and may be omitted, the use of such contacts, co-operating with springs 30 and 31 insures that firm contact is made between the player and the electrodes, firm contact being necessary in order to provide a true reading. The entire electrode assembly is mounted on a suitable surface 32 available to the player.

If switch arm 16 is moved to contact point 17, electrode 28 is connected directly to common ground terminal 39 so that now the device functions purely as an electronic voltmeter and the reading obtained on indicating meter 26 is strictly a function of electric potential difference existing between the points of contact of the player with electrodes 28 and 29.

The preferred method of operation is with switch arm 16 contacting point 15, and this connection may be made permanent if desired, or, if desired, the switch arrangement consisting of lever 16 and contact points 15 and 17 may be included as part of the device, preferably mounted at some point not available to the player.

The bridge balance adjustment comprising slide arm 11 and resistor 10 is so mounted as to not be available to the player, this adjustment being permanent or semi-permanent. While it is normally intended that the bridge will be balanced so that meter 26 reads true zero current, the arrangement as shown by Figure 1 is such that a slight amount of unbalance will not be noticeable to the player, although it will create an error in the final reading obtained on indicating me-

ter 26. This is so because no reading will be obtained on indicating meter 26 until contacts 37 and 38 are closed, at which time a less negative grid voltage is supplied to control grid 5 and a reading is obtained, such reading being accurate only if the bridge is in perfect balance, the reading being high or low by the same amount that the bridge may be unbalanced.

Indicating meter 26, as previously mentioned, comprises a milliammeter, the movement of which may be a standard commercial meter in all respects. For amusement device purposes it is desirable that the reading be obtained on a large dial and this may be accomplished by any desired means. For example, a large dial may be used with the meter pointer having sufficient counter-balanced extension to appropriately fit the dial scale or preferably, the meter movement may be so mounted in front of a source of illumination that a shadow or an illuminated spot is projected on a translucent dial, such arrangements being commonly used for other purposes. The actual dial scale may be either circular, semi-circular or rectangular in the so-called slide rule manner, preferably illuminated, and while numerals such as 0-100 may be used on such a scale, it is preferable, for amusement device purposes, to also include suitable wording at various points on the scale, such wording being so chosen as to indicate a low degree of emotional tension at low scale readings and a high degree of emotional tension at high scale readings.

In addition to acting as an alternating current filter, choke coil 21, condenser 20 and condenser 19 also smooth out any instantaneous voltage changes which normally occur in the average human subject. The effect of this is that indicating meter 26 gives a final reading which is the equivalent of average voltage present at the input to choke 21. The overall effect is equivalent to a highly damped indicating meter where the damping is mechanical, except that in the present instance the damping is electrical, the degree of damping being largely determined by the capacity of condenser 20 and the inductance of choke coil 21.

All of the circuit values must be so chosen that satisfactory readings are obtained on indicating meter 26, and when properly chosen a readable deflection will be given for the lowest voltage and highest resistance values encountered, and for the highest voltage and lowest resistance encountered the deflection should not exceed full scale. For reasons of clarity it is desirable to use a linear scale arrangement, so that due to the wide range of values encountered it becomes necessary to provide a logarithmic or semi-logarithmic circuit arrangement as further explained in more detail in connection with Figure 3.

Referring now to Figure 2, the equivalent circuit of the player is given, where 43 and 42 represent the palms of the player, or such other parts of the player that come in contact with electrodes 28 and 29. The source of voltage is represented by 47 and such voltage source may instantaneously be of either polarity. Resistors 44 and 45 represent the resistance between the points of contact with the electrodes and the source of potential; to a large extent, resistors 44 and 45 represent the skin resistance taken directly through the skin, this resistance being variable, as previously explained. In addition to the series resistance present, a shunt resistance represented by 46 exists between the electrodes.

This resistance may be considered as the surface resistivity between electrodes.

While it is understood that it is impossible to accurately represent such conditions schematically, Figure 2 represents an equivalent circuit which is in agreement with existing biological knowledge, the actual source of voltage being unknown, but presumed to be chemical in nature. Referring now to Figure 3, which represents the preferred condition for operation of vacuum tube 1, where ordinate A represents plate current, abscissa B represents grid voltage and curve C represents the change in plate current with changing grid voltage, the space D between broken lines representing the desirable operating range. Such a condition may be obtained by proper choice of resistance and voltage values, especially resistor 7 which acts as a plate series resistor and resistor 9 which acts as a cathode resistor. With proper choice of such values, the grid voltage on control grid 5 is always negative for static conditions with no input voltage from electrodes 28 and 29 and maximum change in plate current is obtained for low values of grid voltage change in the positive direction. As this grid voltage change increases, the plate current change becomes less, so that maximum reading per unit input is obtained for low values of grid voltage change and curve C becomes sufficiently flat for higher values of grid voltage that maximum scale reading will not be exceeded.

I have described an amusement device which may be used to record the electric potential difference existing between two parts of the anatomy of a player or the ohmic resistance which may exist between such parts. The device, as disclosed, is not responsive to stray field effects of alternating current or high frequency current. The reading obtained is, at least to a degree, related to the instantaneous emotional state of the player, therefore providing an amusement device which is at least in part a scientific instrument. The final reading obtained is free from any influence except the voltage difference and resistance of the player and, by use of a suitable filter circuit, average values are read as a steady state reading, such values not being affected by small voltage fluctuations, and by use of a suitable polarizing current the meter readings obtained are always of the same polarity, the use of such a polarizing current preventing opposite polarity readings.

To summarize briefly the operation of the preferred form of my invention herein described in detail, a pentode vacuum tube 1 and its associated cathode bias resistor form one arm of a Wheatstone bridge, the other three arms of which are formed by fixed resistors 7 and 8, and an adjustable resistor 10, by which the bridge may be balanced. The positive terminal of a high voltage plate supply is connected to terminal 22, which in turn is connected to the junction of resistors 7 and 8. The negative terminal of the supply is connected to terminal 23, which is connected to the grounded junction of resistors 9 and 10 through the coin controlled switch 25. Resistor 12 supplies voltage to the pentode screen, which is by-passed by condenser 13. A meter or other indicating instrument 26 is connected across the conjugate points X and Y of the bridge through the normally open switches 37 and 38. An electrode 28 is connected to switch 16, which may contact switch point 17 or switch point 15 as desired. Electrode 29 is connected to the control grid 5 of vacuum tube 1 through a filter con-

sisting of choke coil 21 and condensers 19 and 20. The filter and the connections from the filter to electrode 29 and to control grid 5 are protected by a grounded shield 27 so as to prevent the circuit from responding to stray fields such as power lines, induction and surges due to arcing commutators, switches, et cetera. Such stray fields as are picked up by the electrode 29 will be by-passed to the ground by the filter and thus be prevented from affecting control grid 5. The design of the filter is such that it will by-pass all alternating components of 30 cycles per second or more, and it serves not only to by-pass stray field pickups but also by-passes rapid fluctuations in the current in the electrode circuit due to changes in the electrical resistance or voltages of the player's anatomy.

To operate the device, the player inserts a coin which closes switch 24 and energizes the bridge. The player then presses his palms against the electrodes 28 and 39 until the meter 26 gives an indication corresponding to the electrical condition of the player. If the switch 16 rests on point 17, the grid 5 of the vacuum tube 1 will be affected by the potential developed by the player between the points of contact with the electrodes. Where the switch 16 rests on point 15, a positive voltage produced by the potential drop between tap 14 on resistor 9 and ground, is added to the potential developed by the player. In either case, the resistance of the player determines what part of the total developed potential will be applied to grid 5. Application of a positive potential to the grid increases the current flow through pentode 1 and unbalances the bridge and, if the player is exerting sufficient pressure on the spring-supported electrodes 28 and 29 to close contacts 37 and 38, the meter will indicate the electrical condition of the player. After a predetermined interval, contacts 25 will open momentarily while the coin is being collected and contacts 24 are being reopened to condition the machine for a succeeding player.

While the foregoing description serves to illustrate the manner in which the objects of my invention may be carried out, nevertheless, it is understood that I do not desire my invention to be limited thereby, but only by the scope of the following claims.

I claim:

1. The method of indicating the instantaneous emotional state of a subject normally exhibiting a potential difference varying in magnitude and polarity between spaced points on the surface of the subject, in response to variations in the emotional state of the subject, comprising applying a biasing potential difference of uniform predetermined value and polarity across spaced points on the surface of the subject, to polarize the natural potential difference between said points, filtering the resultant potential difference to exclude all pulsating and alternating potential to obtain a unidirectional potential difference varying in magnitude as a function of the natural instantaneous potential difference between said points, amplifying said resultant potential difference and electrically indicating the instantaneous emotional state of the subject as a function of the instantaneous value of said amplified potential difference.

2. A device for indicating the instantaneous emotional state of a subject exhibiting an electric potential difference between spaced points on the body of the subject, which potential difference varies in magnitude and polarity in response to variations in the emotional state of the subject, comprising an electronic amplifier including an input circuit and an output circuit, a pair of spaced external electrodes to be engaged by the body of the subject and operatively coupled to said input circuit, a source of electric potential, means connecting said source with said spaced electrodes and for superposing therebetween a potential difference of predetermined uniform magnitude and polarity, said input circuit including a low-pass filter to exclude all pulsating and alternating potential to insure a unidirectional potential bias on the input of the amplifier, the value of which is a function of the instantaneous potential difference existing between said spaced electrodes, and an electric indicating instrument operatively connected across the output circuit of the amplifier to indicate the instantaneous emotional state of the subject as a function of the potential difference between said electrodes.

3. A device for indicating the instantaneous emotional state of a subject exhibiting an electric potential difference between spaced points on the body of the subject, which potential difference varies in magnitude and polarity in response to variations in the emotional state of the subject, comprising a resistance bridge network including an electronic amplifier connected in series with a resistor across one arm of the bridge, a source of unidirectional potential connected across one pair of conjugate points of the bridge, said electronic amplifier including a cathode, an anode and an input electrode, said resistor being connected between the cathode and one of said pair of conjugate points, a pair of spaced, external electrodes to be engaged by said subject, means connecting said electrodes in series with said input electrode and a point on said resistor between the cathode and said one of said pair of conjugate points, to thereby superpose on and between said spaced electrodes a biasing potential of predetermined uniform magnitude and polarity, said series connection between the spaced electrodes and said input electrode including a low-pass filter to exclude all pulsating and alternating potential to thereby superpose on said input electrode a unidirectional bias varying in magnitude as a function of the instantaneous potential difference between said spaced electrodes, and an electrical indicating instrument connected across the other pair of conjugate points of the bridge to thereby indicate the instantaneous emotional state of the subject as a function of the amplified potential difference between said spaced electrodes.

4. The device of claim 3 wherein at least one of said external electrodes is movable in response to engagement thereof by said subject, and wherein the means connecting said electrical indicating instrument to said other pair of conjugate bridge points includes at least one normally open switch arranged to be closed by the movement of said movable electrode.

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Jan. 18, 1944.

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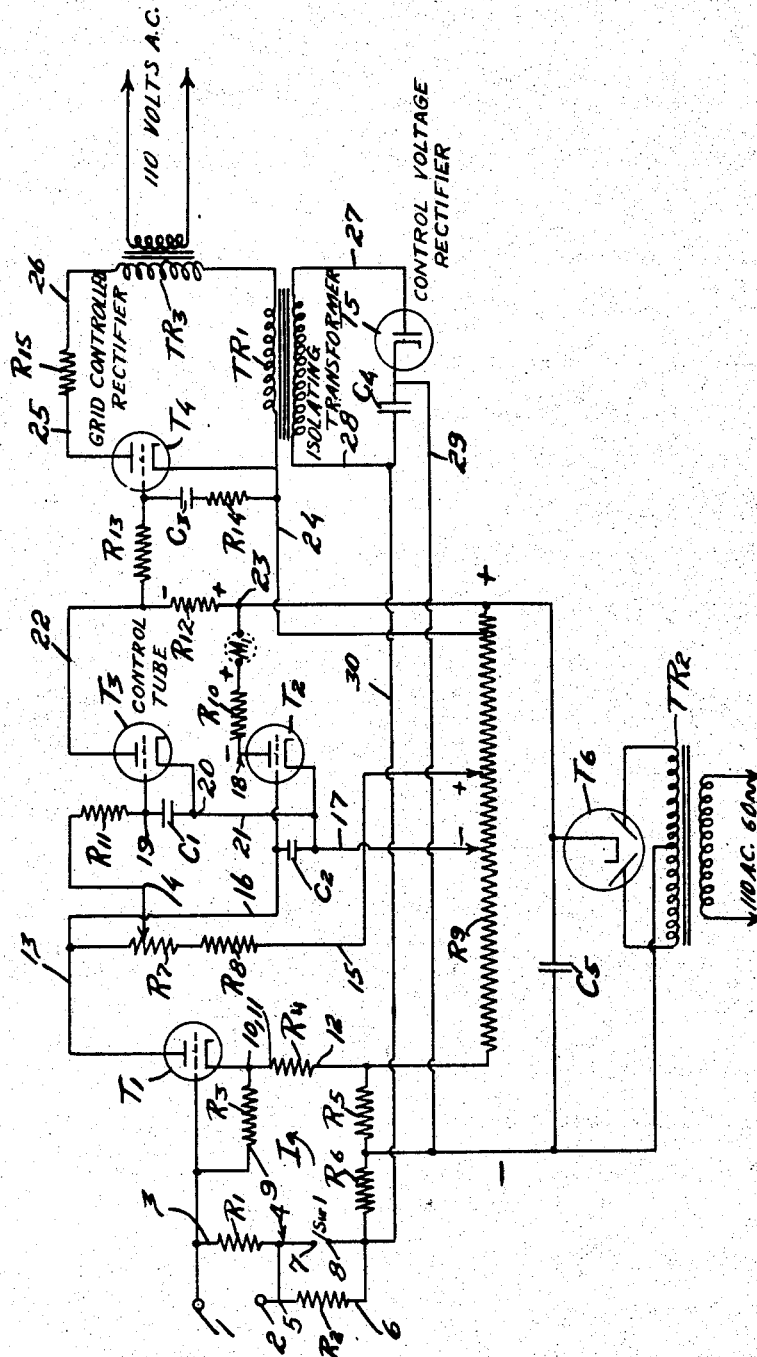
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PSYCHOMETER

Filed Feb. 20, 1941

2 Sheets-Sheet 1

Fig. 1



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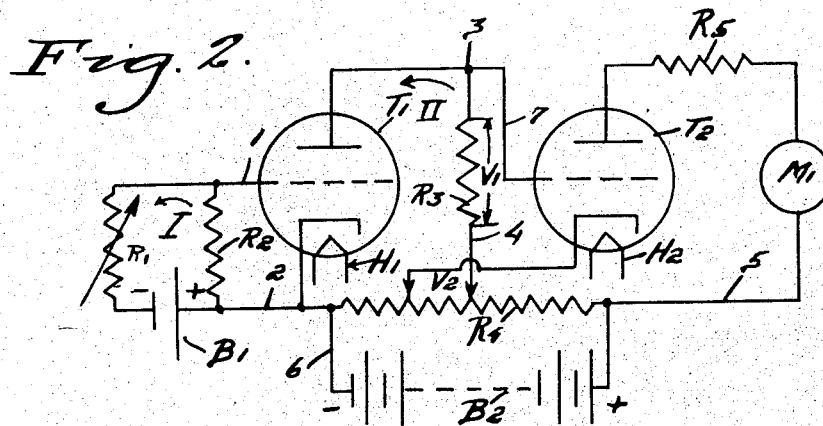
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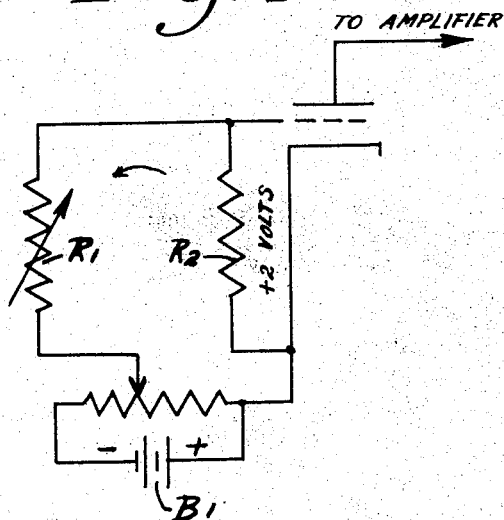
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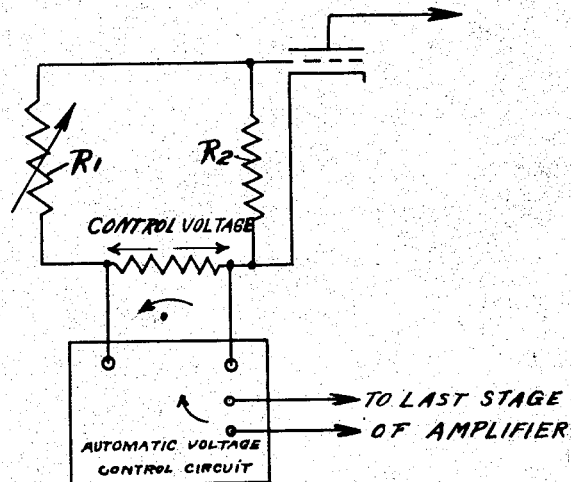
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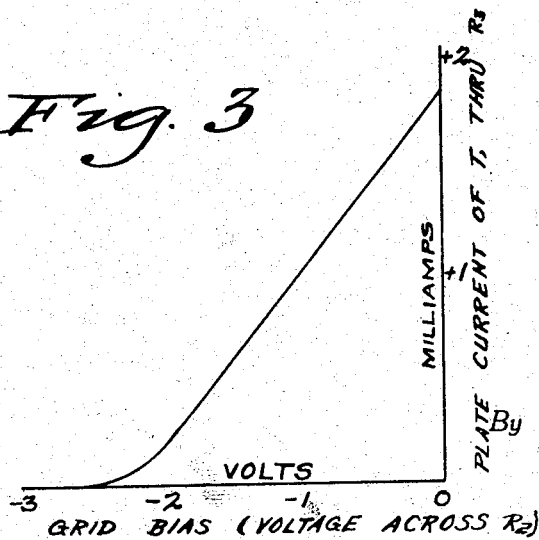
*Fig. 4*



*Fig. 5.*



*Fig. 3*



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## UNITED STATES PATENT OFFICE

2,339,579

## PSYCHOMETER

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Application February 20, 1941, Serial No. 379,910

11 Claims. (Cl. 128-2.1)

Our invention relates to means to detect small decreases in electrical resistance, and the primary object of the invention is to provide means for detecting such decreases in the electrical resistance between two points on the palm of the hand, regardless of the resistance level existing between these points, said detection being accomplished automatically and without the use of a manual control, thereby enabling any unskilled person to operate the device as a "lie detector" without requiring the presence or instruction of a trained psychologist or other technician.

Other important objects and advantages of our invention will be apparent from a reading of the following description of the appended drawings wherein a preferred embodiment of our invention is shown for illustrative purposes.

In the drawings—

Figure 1 is a diagrammatic representation showing the components and their electrical connections comprising said embodiment.

Figure 2 is a wiring diagram showing the fundamental two-stage direct coupled amplifier circuit employed.

Figure 3 is a diagram illustrating the variation of the current flow through the load resistance  $R_3$ , or a tube characteristic curve.

Figure 4 is a diagram of a manually controlled voltage divider, the purpose of which is to compensate for various values of  $R_1$ .

Figure 5 indicates that the manual control of Figure 4 has been eliminated by the introduction of the "automatic voltage control circuit" in this embodiment.

The primary utility presently contemplated for the invention is that of producing meter readings or recordings showing a subject's psychogalvanic responses to various stimuli, but the device is not necessarily limited to this use.

The complete device is shown in Figure 1 of the drawings. The individual compositions and actions of the circuit elements are herein explained in advance of explanation of their cooperative functions described subsequently in this specification, in order that the functioning and operation of the invention may be clearly set forth.

The fundamental amplifier circuit is shown in Figure 2 and operates as follows:

$R_1$  is a variable resistance capable of offering any resistance value between zero and 500,000 ohms. This circuit element is substituted in Figure 2 as the electrical equivalent of the skin resistance between the electrodes when these electrodes are connected to the subject's palm. A small decrease in the resistance of  $R_1$  is the elec-

trical equivalent of the "psychogalvanic response" which is the psychological phenomenon to be detected.

$B_1$  is a small battery which impresses a voltage of approximately 5 volts on the circuit composed of  $R_1$ ,  $R_2$  and  $B_1$ . The current flow in this circuit will be equal to the battery voltage divided by the sum of the resistance  $R_1$  and  $R_2$ , and the fact that each end of  $R_2$  is connected to an element of the vacuum tube amplifier  $T_1$  has no effect on this current flow since the grid of  $T_1$  is at a negative potential with respect to the cathode. The voltage drop across  $R_2$  will be equal to the battery voltage minus the drop across  $R_1$ . By connecting the negative end of  $R_2$  to the grid or control element of the vacuum tube amplifier  $T_1$  by means of wire 1, and by connecting the positive end of  $R_2$  to the cathode element of  $T_1$  by means of wire 2, the voltage drop which is present across  $R_2$  due to the current flowing in circuit 1 is impressed as grid bias on  $T_1$ . When  $R_1$  is reduced to a lower resistance value (which represents the psychogalvanic response) more current will flow in circuit 1 and there will be a greater voltage drop across  $R_2$ .

The plate of the tube  $T_1$  is connected to a resistance  $R_3$  by means of wire 3. Wire 4 connects the other end of  $R_3$  to a point of the voltage divider  $R_4$ . The extremities of this voltage divider are connected to a high voltage "B" battery by wires 5 and 6, wire 5 being the positive terminal. If the battery voltage is 200 volts, wire 4 is connected to a point at which the potential difference between 6 and 4 is approximately 100 volts or half the supply voltage. Since wire 6 is connected to wire 2 and to the cathode of  $T_1$ , and since wire 4 is connected through the resistance  $R_3$  to the plate of  $T_1$ , it follows that there will be a positive potential impressed between the plate and cathode of  $T_1$ . When the cathode of  $T_1$  becomes heated and emits electrons, these electrons will flow through the control grid to the positively charged plate, thus causing a flow of current in the circuit composed of  $T_1$ ,  $R_3$  and the section of  $R_4$  which supplies the impressed plate voltage. If this supply voltage remains constant, the current through  $R_3$  will depend on the grid bias impressed on  $T_1$  which is obtained from the voltage drop across  $R_2$ . The current through  $R_3$  will change in the manner indicated in Figure 3.

From the tube characteristic curve of Figure 3, it may be seen that there will be no current through  $R_3$  or  $T_1$  when the grid bias (or the voltage drop across  $R_2$ ) is more negative than

-2.5 volts. When the grid bias on  $T_1$  is -1 volt, however, a certain current will flow through  $R_3$ . This current  $I$  is indicated in the conventional manner as flowing from plus to minus in a counter clockwise direction and producing a voltage drop across  $R_3$  designated as  $V_1$ . The end of  $R_3$  will be positive with respect to the end when current flows.

Considering the circuit thus far, if  $R_1$  is decreased suddenly by a given ohmic value (which represents the psychogalvanic skin response to be amplified), more current will flow in circuit I, this circuit being composed of  $R_1$ ,  $R_2$  and  $B_1$ . Since more current flows through  $R_2$  the voltage drop across it will become greater when the change in  $R_1$  takes place. This in turn means that the grid bias on  $T_1$  will increase from -1 to -1.2 volts for example. Referring to Figure 3, it may be seen that this change in grid bias will change the plate current or the current through  $R_3$  by some value. This decrease of current through  $R_3$  will cause a decrease in the voltage drop designated as  $V_1$ .

Since the variation in  $V_1$  is small when a response occurs, additional amplification is required. Essentially the same process is repeated again. As an illustration, assume that the voltage drop across  $R_3$  ( $V_1$ ) changes from 20 to 18 volts when a decrease in the subject's skin resistance takes place. The characteristic curve for the second amplifier tube  $T_2$  is the same as that for  $T_1$ , so if this 20 volts were applied as grid bias for  $T_2$ , no plate current could flow. In order to make the second tube operate at all, it is necessary to reduce its grid bias to about -2 volts, and this is accomplished by connecting the cathode of  $T_2$  to a point on the voltage divider  $R_4$  which is approximately 17 volts more negative than the point where  $R_4$  wire connects. This voltage is designated as  $V_2$ . Since  $V_1$  and  $V_2$  are in opposite directions, the net grid bias applied to  $T_2$  will be their difference. In terms of the illustration, this bias will be -20 +17 or -3 volts before the response, and -18 +17 or -1 volt after the change. Considering Figure 3 again, it will be seen that a change of grid bias between -3 and -1 volt produces a variation between zero and approximately 1.5 milliamperes in the plate current of  $T_2$ . If a 1 milliamper meter, as diagrammatically illustrated at  $M_1$  in Figure 2, is placed in the plate circuit of  $T_2$ , full scale deflections may be obtained when  $R_1$  is decreased slightly. The purpose of  $R_3$  is to limit this plate current to 1 milliamper.

When the ohmic value of  $R_1$  is slightly reduced in the two-stage direct coupled amplifier the following take place:

1.  $R_1$  offers less resistance to its circuit.
2. The current increases through  $R_1$ ,  $R_2$  and  $B_1$ .
3. The voltage drop across  $R_2$  increases slightly.
4. Tube  $T_1$  receives more negative bias.
5. The plate current through  $R_3$  decreases by an amount dependent upon the amplification constant of the tube.
6. The voltage drop across  $R_3$  decreases.
7. The grid bias on  $T_2$  becomes less negative.
8. Much more current flows through  $T_2$  and a meter reading is obtained.

With this understanding of the operation of the direct coupled amplifier, the explanation of the complete circuit is made much simpler. As has been stated, the complete circuit was de-

signed to amplify small decreases in  $R_1$  regardless of its resistance value. This could be done by a manually adjustable resistance or potentiometer  $R_3$  such as is indicated in Figure 2, wherein a potentiometer or voltage divider is connected across the battery  $B_1$  so that the voltage impressed across  $R_1$  and  $R_2$  may be varied. Assuming that it is desired to have the milliammeter of Figure 2 resting at a point slightly above zero so that full scale deflections may be measured, and that in order to obtain this condition the grid bias on  $T_1$  must be -2 volts, the voltage drop across  $R_2$  must always be two volts. If  $R_1$  (which represents the subject's skin resistance) is very high in its ohmic value, only a very small current will flow through  $R_2$  and there will not be the required two volt drop across it. On the other hand, if the subject's skin resistance is very low, there may be a three volt drop across  $R_2$ . To compensate for this variation in individuals, the voltage divider could be adjusted to the required point so that there is a two volt drop across  $R_2$ . The meter in the second stage would then rest at a point just above zero, and when the decrease in  $R_1$  took place the meter would show an increase in current as previously explained.

This type of control, or some other manual control is used in common circuits to maintain the meter at an above-zero rest point. In some "lie detectors" three or four controls are necessary to accomplish what the present device does automatically. Every individual has a different level of skin resistance, and with the present type of metal electrodes this level of resistance is continually changing. To compensate for these changes an operator is required to make frequent adjustments in order to maintain the meter at its predetermined rest point. These adjustments are necessarily subjective in nature and are therefore a source of error and waste of time.

In the present device the voltage divider of Figure 4 is replaced by a fixed resistance and an automatic voltage control circuit as shown in Figure 5. The function of the automatic voltage control circuit is to maintain a sufficient voltage drop across the fixed resistance so that just enough current will flow through  $R_2$  to produce a two volt drop across it regardless of the resistance of  $R_1$ . If the subject's resistance is high, the control voltage will build up to 12 or 15 volts, or until the meter in the second amplifier tube is "floating" above zero. On the other hand, if the subject's resistance is low, the control voltage will fall to some low value so that the meter is still just floating. During an experiment the subject's resistance may "drift" through several hundred thousand ohms. This drifting is a slow change not to be confused with the psychogalvanic response, and as it takes place, the control voltage will drift correspondingly so that the meter rests at the same predetermined rest point. Meter deflections are obtained only when an actual response occurs, and the meter is returned to its floating position immediately after the response reaches its maximum magnitude.

In order to accomplish this function, the control voltage must fulfill the following requirements:

1. It must have sufficient magnitude to cause the meter to rest just above zero regardless of the value of the subject's resistance.
2. It must be completely isolated and entirely

independent of the supply voltage; otherwise a short circuit would result.

3. It must remain essentially constant throughout the duration of the psychogalvanic response which is to be detected; otherwise the meter deflections due to actual responses would be canceled by the action of the control circuit.

The problem having been stated and the required operation outlined above, the circuit as a whole will now be discussed. It is to be understood that several variations on this circuit are possible of which the essential characteristics are as follows:

(1) An input circuit of which the electrodes are a part.

(2) An amplifier circuit capable of amplifying irregularities or variations in the magnitude of direct current flowing through a resistance, said variations being caused by the psychogalvanic response. A complex current of this nature apparently has a component of zero frequency, upon which is superimposed a pulsating current component, the alternations or variations of which occur at irregular rate. The pulsations are a small percentage of the total current and occur irregularly with varying amplitude.

(3) A time delayed control tube circuit.

(4) A means of converting the output of this delayed circuit from direct to alternating current.

(5) A means of isolating the output of the delayed control circuit from the supply voltage for the amplifier tubes.

(6) A means of rectifying this isolated voltage and applying it to the input circuit of the amplifier.

(7) A means of adjusting the rest point of the meter.

(8) A means of controlling the sensitivity of the amplifier.

In Figure 1 of the drawings showing the complete circuit of the present device, 1 and 2 are the metal electrodes which are placed in contact with the subject's palm and held firmly. Electrode 1 is connected to point 3 which is one end of a 500,000 ohm resistor. Electrode 2 is connected to point 4, the other end of this resistor. The purpose of this resistor is to limit the voltage developed by the automatic voltage control circuit as will be explained later. It is also a shunt resistance across the electrodes to limit the range to be covered to values under 500,000 ohms.

Points 5 and 7 are also connected to electrode 2. Point 5 is one end of the resistance  $R_2$  and point 6 is the other end of this resistance.  $R_2$  has an ohmic value of 50,000 ohms, and its function is to decrease the sensitivity of the amplifier by acting as a resistance in series with the electrodes. When a change takes place in the subject's resistance, about 50 per cent of the voltage variation produced will take place across this resistance and limit the change taking place across  $R_3$ . This in turn limits the meter reading obtained to about 50 per cent of that which would be obtained if  $R_2$  had been shorted by the switch  $Sw_1$ .

Points 6 and 8 are connected together, point 8 being one terminal of a single pole throw switch, and point 7 being the other. This switch, designated as  $Sw_1$ , is provided as a means of sensitivity control. If this switch is open,  $R_2$  performs the function described above, but if  $Sw_1$  is closed,  $R_2$  is short circuited and no longer decreases the sensitivity of the apparatus. It was

found that persons with strong reactions gave "off-scale" deflections of the meter regardless of the stimulus, so this means of decreasing the sensitivity was provided so that a more quantitative measure could be obtained.

Points 9 and 10 are the terminals of the resistor  $R_3$ , this resistor having a value of 50,000 ohms. Point 9 is connected to point 3, and 10 is connected to the cathode of the first amplifier tube  $T_1$ . Point 9 is also connected to the grid element of  $T_1$ . The function of  $R_3$  is to provide a voltage drop in the electrode circuit which may be applied to  $T_1$  as grid bias. The voltage drops developed in the resistors  $R_4$ ,  $R_5$  and  $R_6$  are applied to the circuit consisting of  $R_1$ ,  $R_2$  and  $R_3$  causing a flow of current indicated by I. This current produces a voltage drop across  $R_3$ , point 9 being negative with respect to point 10. When a decrease of the subject's resistance takes place, the current through  $R_3$  increases and the grid bias on  $T_1$  is therefore increased (in a negative direction) and the plate current in  $T_1$  is decreased.

Points 11 and 12 are the terminals of a 2,500 ohm resistance  $R_4$ . Point 10 is connected to the cathode of  $T_1$  and to the point 11. Since the plate current of  $T_1$  must flow through  $R_4$  also, a small voltage drop will be produced across it. This drop is used as a certain percentage of the voltage applied to the electrode circuit, and is in the same direction as the voltage drop across  $R_3$  and  $R_4$ .

Wire 13 connects the plate of  $T_1$  to one end of the potentiometer  $R_7$ , while the other end of said potentiometer is connected to  $R_6$ . The values of these resistors are 250,000 ohms each,  $R_7$  having a variable tap which controls the rest point of the meter.  $R_7$  and  $R_6$  provide the load resistance for  $T_1$  and the grid bias voltage for the following amplifier tube  $T_2$  and the control tube  $T_3$ . The reason why the variable tap 14 on  $R_7$  controls the rest point of the meter is explained further on herein.

Wire 15 connects  $R_6$  to a point which is approximately at the center of the voltage divider  $R_8$ . It is from this point that  $T_1$  obtains its plate voltage.

Wire 16 connects the plate of  $T_1$  to the grid of  $T_2$ , and wire 17 connects the cathode of  $T_2$  to the junction of the wire 17 and the voltage divider  $R_8$ , which point is approximately 60 volts more negative than the point where wire 15 is connected. This voltage drop is in a direction opposite to that across  $R_7$  and  $R_6$ , with the result that the net grid voltage on  $T_2$  is within the operating limits of the tube. If wire 17 were connected directly to wire 15, the grid bias on  $T_2$  would be far beyond the plate current cut-off point, but by connecting 17 to a point more negative than 15, the grid bias on  $T_2$  may be brought nearer zero so that plate current flows and a meter reading may be obtained.

Wire 18 connects the plate of tube  $T_2$  to its load resistance  $R_{10}$ . The value of this resistance is about 150,000 ohms, and its function is to limit the plate current of  $T_2$  to one milliamper which is the current required to give a full scale deflection of the meter  $M_1$  of Figure 1, to one side of which  $R_{10}$  is connected. The other side of the meter  $M$  is connected to the positive side of the voltage divider  $R_8$  which supplies plate voltage for the amplifier tubes.

The operation of the circuit thus far is as follows:

a. When a psychogalvanic response takes place

between the electrodes 1 and 2, the electrical resistance between these points is suddenly decreased by a small ohmic value.

b. This decrease of resistance causes more current to flow through the resistance  $R_s$ , and increases the voltage drop across it by a small amount.

c. Since  $R_s$  is connected to the input terminals of the amplifier tube  $T_1$ , the grid bias between these elements will be increased, and the flow of electrons from cathode to plate will be decreased due to the repelling and controlling action of the grid wires.

d. Since the plate current for  $T_1$  flows through  $R_7$  and  $R_8$ , there will be a sudden decrease in the voltage drop present across these combined resistors.

e. Since the second amplifier tube obtains its grid bias from the difference between the drop across the resistors  $R_7+R_8$  and the aforementioned portion of the voltage divider  $R_6$ , the plate current through  $T_2$  will increase from nearly zero to some value less than one milliamper and dependent upon the gain of the amplifier and the magnitude of the initial variation of the subject's resistance.

This completes the disclosure of the amplifier circuit itself, and the additions which have been made to deliver the required variable voltage drop across the resistance  $R_6$ , which additions constitute the automatic control feature, will now be explained.

Since the operation of the automatic voltage control circuit is to bring the meter back to a rest point just above zero, its action must be dependent upon the current flowing through the meter. If a resistor were placed in series with the meter, the voltage drop across this resistor would be proportional to the current flowing through the meter. If this voltage were then isolated from the supply voltage for the amplifier tubes and applied to the electrodes in the opposite direction with respect to the already existing grid bias for the first tube, the action would be as follows: When there was no current flowing through the meter, there would be no control voltage "bucking" the grid bias on the first tube of the amplifier. As a result, the voltage across the electrodes would be at its maximum value. When a person placed his hand across the electrodes, the meter would immediately go off scale. With current flowing through the meter, there would be a voltage drop in the meter resistance which, when brought back to the input circuit, would tend to decrease the electrode voltage or the bias on the first tube. Regardless of what resistance was placed across the electrodes, the meter would always be brought to zero by this action. If this control action were made very slow in its operation, meter deflections would be obtained when responses occurred, and the rapid rise and fall of current through the meter would not effect the "control voltage" at all. This is the fundamental idea behind our invention, but the desired operation was accomplished in a somewhat different manner.

Instead of using the current through the meter as the controlling factor, another tube "in parallel" with the second amplifier has been added. This "control tube" operates essentially the same as the second amplifier tube with the exception that its action is delayed. When a resistance is placed across the electrodes, the current in the second amplifier tube rises immediately to 1-milliamper or its maximum value. Due to the fact

that a time delay resistance and condenser combination  $R_{11}$  and  $C_1$  of Figure 1 is connected to the grid of the control tube  $T_3$ , the current in the plate circuit of this tube will not reach its maximum value for two or three minutes. A resistance  $R_{12}$  in the plate circuit of the tube  $T_3$  will deliver the slowly changing control voltage required to give the desired operation mentioned above.

It would be a simple matter to apply this voltage to the electrode circuit directly except for the fact that a short circuit of the power supply for the amplifier tubes would result. Some means of isolating this voltage had to be devised. The simplest method of coupling two circuits without any electrical connection is by means of a transformer, but this method requires alternating current. The voltage appearing across the plate resistance of the control tube must therefore be changed into alternating current by some means. This voltage was therefore made to control the flow of pulsating direct current in a "grid controlled rectifier" circuit by using the voltage as grid bias.

This "grid controlled rectifier" circuit consists of no more than a tube  $T_4$  of Figure 1 in series with two transformers, wherein the transformer  $TR_3$  impresses an A. C. voltage on this circuit, but due to the fact that no current can flow through the tube during the half cycle when the plate is negative with respect to the cathode, only the current pulses of the other half cycle flow through the circuit. The magnitude of these pulses is controlled by the voltage drop across the resistance in the plate circuit of the control tube, this magnitude being inversely proportional to the grid bias as illustrated in Figure 3. The greater the flow of current through the control tube, the less will be the amplitude of the D. C. pulses through the grid controlled rectifier. The other transformer in this circuit is the "isolating transformer." The D. C. pulses in the primary winding are transformed into alternating current in the secondary winding.

The A. C. output of the isolating transformer is then converted back into direct current by the action of the "control voltage rectifier tube  $T_5$  of Figure 1." This output is in turn filtered and applied to the terminals of a resistance in the electrode circuit. The voltage drop across the resistance  $R_6$  is the "control voltage" and is directly dependent on the current flowing in the grid controlled rectifier circuit and inversely dependent on the current flowing in the plate circuit of the control tube. For this reason, instead of connecting the control voltage so it bucks the fixed bias on the first tube, it is connected so it adds to this bias thus returning the meter to zero.

Before giving a specific description of the circuit, its operation is reviewed as follows: When there is no subject connected to the electrodes, the first amplifier tube will be practically at zero bias and the current in its plate circuit will be at a maximum. The voltage drop across the resistance in this plate circuit will be high, so the second amplifier tube will be at plate current cut-off and no current will flow through the meter. The control tube, which has practically the same bias as the second amplifier, will be very nearly at cut-off, and the drop across the plate resistance in its circuit will be very small. As a result, the pulsating current flowing in the grid controlled rectifier circuit will be a maximum, since this tube has zero bias. The A. C. output

of the isolating transformer will also be at its maximum value, and hence the control voltage will be high. When a person places his hand across the electrodes, the control voltage is sufficiently high, regardless of the subject's resistance, to bias the first tube almost to cut-off. The second amplifier tube then has a low value of grid bias, and it draws maximum current. About a minute later the control tube begins to draw current through its load resistance. This starts to give the grid controlled rectifier more bias, thus reducing the flow of pulsating D. C. current and the electrode control voltage. As soon as the control voltage has fallen to the point where the meter is almost at zero, the control tube plate current stops increasing and the control voltage is maintained at whatever value is required to make the meter float just above zero. The subject's responses are a rapid decrease and slightly slower increase of resistance giving rise to a cliff type curve, the recovery portion not always returning to the same level as that from which it started. These pulses are so rapid that the bias on the grid controlled rectifier remains essentially constant due to the action of the time delay circuits. If there is no recovery, however, this bias changes, and the meter is automatically returned to its rest point.

To continue with the specific disclosure, wire 14 connects the load resistance  $R_7$  of the first amplifier to the time delay resistance  $R_{11}$ . The point at which wire 14 connects to  $R_7$  is made adjustable so that the rest point of the meter may be controlled. Moving this tap changes the bias on the control tube  $T_3$  and hence changes the point at which the control voltage will "settle down."

Point 19 is the grid end of the time delay resistance. This resistance has a value of approximately 30 megohms, and its function is to provide a high resistance path to the flow of the charging current for the time delay condenser  $C_1$ . The higher the resistance of this element, the slower will be the rate of charge and discharge of the condenser  $C_1$ .

Point 19 is connected to the grid of the time delay control tube  $T_3$ .

Point 20 is the cathode side of the condenser  $C_1$ , this condenser being connected directly from grid to cathode of the tube  $T_3$ .  $C_1$  is a high grade paper condenser having a capacity of 1-microfarad.

The cathode of  $T_3$  is connected to the cathode of  $T_2$  by means of wire 21. This connection is made so that  $T_3$  will have the same plate supply voltage as  $T_2$ .

Between wires 16 and 17 (or from grid to cathode of  $T_2$ ) is connected another 1-microfarad paper condenser,  $C_2$  of Fig. 1, the function of which is to dampen down small fluctuations in the circuit and to make the action of the meter slightly smoother.

Wire 22 connects the plate of  $T_3$  to its load resistance  $R_{12}$ . This resistor has a value of 20,000 ohms, and the drop across it is used to control the electrode voltage or "control voltage." When  $C_1$  discharges, the current through  $R_{12}$  increases. Wire 23 connects the other end of  $R_{12}$  to the positive terminal of the voltage supply.

Wire 22 is connected to resistance  $R_{13}$  and the other end of this resistance goes to the grid element of the "grid controlled rectifier"  $T_4$ . The resistance  $R_{13}$  is an additional time delay resistance of 10 megohms and decreases the charging rate of the condenser  $C_3$ .

$R_{14}$  is 5 megohms in series with  $C_3$ . This combination of  $C_3$  and  $R_{14}$  is connected from grid to cathode of the tube  $T_4$ . As the voltage across  $R_{12}$  is building up,  $C_3$  begins to charge and  $T_4$  receives more bias.  $C_3$  is a paper condenser of 1-microfarad.

Wire 24 connects the cathode of  $T_4$  to a point on the voltage divider which is about 20 volts less positive than the positive end of  $R_{12}$ . This connection is made to prevent  $T_4$  from going to cut-off (zero plate current) when there is a drop across  $R_{12}$ . When there is no drop across  $R_{12}$  the grid of  $T_4$  has positive polarity, but no appreciable grid current can be drawn since  $R_{13}$  has such a high ohmic value.

Wire 25 connects the plate of the grid controlled rectifier  $T_4$  to a current limiting resistance  $R_{15}$  which has a value of 500 ohms. Wire 26 connects the other end of this resistance to the power transformer  $TR_1$ . This transformer delivers 250 volts across the secondary winding when the primary side is connected to 110 volts A. C. It supplies A. C. plate voltage for the tube  $T_4$  which only allows the half cycle during which the plate is positive with respect to the cathode to pass through the circuit. The transformer  $TR_1$  (primary side) is connected from cathode  $T_4$  to the other side of the power transformer  $TR_1$ . Pulsating direct current flows through this circuit composed of  $T_4$ ,  $TR_1$  and  $TR_3$ , the amplitude of which current depends upon the grid bias of  $T_4$ .

$TR_1$  is an "audio" transformer having a step-up ratio of 1 to 4. The pulses of direct current flowing through its primary cause alternating current to be induced in the secondary winding. Wire 27 connects one side of the secondary winding to the plate of a rectifier tube  $T_5$ , and at the other side 28, there will be present the variable negative voltage applied to the electrode circuit. This variable voltage controls the current flowing in the electrode circuit and, therefore, the current flowing in meter  $M_1$  of Figure 1.  $C_4$  is connected between 28 and the cathode or positive terminal of  $T_5$ .  $C_4$  is a low voltage 8-microfarad filter condenser which tends to remove the pulsations or A. C. components which would otherwise be present in the output of the rectifier  $T_5$ .

Wire 29 connects the cathode of  $T_5$  to the negative terminal of the voltage divider which is in turn connected to a point at the junction of  $R_6$  and  $R_8$ . Wire 30 connects the negative terminal of the output of the control voltage rectifier  $T_5$  to the end of  $R_6$  which is not connected to  $R_8$ . The D. C. voltage drop across  $R_6$  is termed the "control voltage" since it is this voltage which controls the operation of the entire circuit.

The power supply for the amplifier tubes is standard and delivers 500 volts of filtered D. C. into the bleeder resistance or voltage divided  $R_9$ , equal to 25,000 ohms.  $C_5$  is the filter condenser of 8-microfarads.

The resistance  $R_6$  is equal to 100 ohms and is connected in series with the bleeder resistance  $R_9$ . The small voltage drop obtained across this resistor is used as a certain percentage of the fixed bias on the first tube  $T_1$ , the rest being obtained from the drop across  $R_4$ .

$R_8$  has a value of between 3,000 and 5,000 ohms depending on the output of the automatic voltage control circuit.

In a circuit of this nature the absolute magnitudes of the various currents and voltages present is not important. The manner in which these

quantities change during operation is important, however, and a more lucid explanation of the operation may be given if relative rather than absolute terms are used. Many variations in the circuit constants, the sizes of condensers and resistors, are possible, but due to the degenerative nature of the circuit, the ultimate results will be essentially the same. The interdependence and interrelations between the elements of the concatenation are exhibited by the following resume of operation.

To put the device in operation, the designated points of Figure 1 are connected to a 110 volt alternating current source. Before the subject to be tested is connected to the electrodes, the following relative conditions exist in the circuit:

(1) The current through the electrode circuit consisting of the resistors  $R_1$  to  $R_6$ , inclusive, is small, being limited by  $R_1$  which is a high resistance across the electrodes. What current does flow is caused largely by the voltage drop present across  $R_6$ , which, as will be seen presently, is relatively high.

(2) Since the current flow through  $R_3$  is small, there will only be a small voltage drop across it, hence only a small negative voltage on the control grid of  $T_1$ .

(3) With only a small value of grid bias on  $T_1$ , the current in the plate circuit of this tube will be high, thus causing a high voltage drop across the resistors  $R_7$  and  $R_8$ .

(4) Since the voltage drop across  $R_7$  and  $R_8$  is applied to  $T_3$  and  $T_4$  as grid bias, these two tubes will be biased almost to the point of plate current cut-off. The indicating meter  $M_1$  will be almost at zero, and there will only be a slight voltage drop across  $R_{12}$ .

(5) Since the voltage drop across  $R_{12}$  is small, there will be very little negative bias on  $T_4$ , hence the magnitude of direct current pulses flowing through this tube and the transformers in series with it will be high.

(6) Since the current flowing through the primary winding of the isolating transformer  $TR_1$  is high, the alternating current voltage appearing across the secondary is high, with the result that the rectified voltage across  $C_2$  and  $R_9$  is high, as was stated in (1) above. To be more quantitative, the voltage across  $R_9$  is just high enough to force enough current through  $R_4$  to deliver enough bias to  $T_1$  to make the indicating meter rest at a point just above zero.

(7) When a subject is connected to the electrodes, the effect is the same as though  $R_1$  were decreased about 50 per cent. This means that much more negative bias would appear on  $T_1$  due to the increase of current through  $R_3$ .

(8) Since the plate current of  $T_1$  is greatly reduced by this increase of bias, the drop across  $R_7$  and  $R_8$  will be reduced, thus reducing the bias on  $T_3$ .

(9) The indicating meter in the plate circuit of  $T_2$  will therefore read full scale, and the time delay condenser  $C_1$  will begin to discharge through the high resistance  $R_{11}$ , thus decreasing the bias on  $T_3$  and increasing its plate current slowly.

(10) As the plate current of  $T_3$  increases, the drop across  $R_{12}$  increases, and the second time delay condenser  $C_3$  begins to charge up through the high resistance  $R_{13}$ .

(11) As  $C_3$  charges up, the negative bias on  $T_4$  increases, decreasing the pulsating current flowing through  $T_4$ ,  $TR_3$  and  $TR_1$ .

(12) The secondary voltage of the isolating transformer is therefore decreased, hence the voltage drop across  $R_9$  is decreased.

(13) Within approximately one minute, this process reaches an equilibrium condition, and all currents stop changing. This point of balance is determined by setting the variable tap on  $R_7$ , the latter being adjusted so that the indicating meter rests just above zero regardless of the resistance connected between the electrodes, i. e., the subject. In order for the circuit to operate in the manner described, there must of necessity be some variation of current through the meter when high and low resistance subjects are connected to the electrodes, but this variation is small and does not require compensation.

(14) Now, if a small sudden decrease in resistance takes place at the electrodes, the general effect will be the same as that described for the large reduction of resistance that took place when the subject was originally connected. However, due to the relative rapidity with which the resistance across the electrodes is decreased and subsequently increased to approximately its former value when a response takes place, the voltage across  $R_9$  does not have sufficient time to change appreciably. The bias on  $T_2$  is instantly decreased slightly when a response takes place, therefore the meter indicates an increase of current, but the two time delay circuits connected to the control grids of  $T_3$  and  $T_4$  operate to maintain the voltage applied to the electrode circuit at a constant value during a response.

(15) If the subject experiences a severe emotional shock, his electrical resistance may decrease and not come back again to its former level. It is this fact which makes it necessary to make some manual compensating adjustment to psychogalvanometers previously developed, but from this disclosure, it will be observed that the indicating meter is automatically restored to its original rest point through the delayed action of the automatic voltage control circuit.

Although we have shown and described herein a preferred embodiment of our invention, it is to be definitely understood that we do not wish to limit the application of the invention thereto, except as may be required by the scope of the subjoined claims.

Having described the invention, what is claimed as new is:

1. A device for automatically detecting decreases in the electrical resistance between two points on a body regardless of the resistance level existing between these two points before the change took place, said device comprising a pair of electrodes to contact the said points, an input circuit including said electrodes, an amplifier circuit capable of amplifying direct current changes fed by said input circuit, a time delay control tube circuit, first means for converting the output of the time delay control circuit from direct to alternating current, second means for isolating the output of the time delay control circuit from the supply voltage for said amplifier circuit, third means for rectifying the resultant isolated voltage and applying the rectified resultant to the input of said amplifier circuit, fourth means for adjusting the sensitivity of said amplifier circuit, a meter operated by said amplifier circuit, and fifth means for adjusting the rest point of said meter.

2. A device for automatically detecting decreases in the electrical resistance between two points on a body regardless of the resistance level



existing between these two points before the change took place, said device comprising a pair of electrodes to contact the said points, an input circuit including said electrodes, an amplifier circuit capable of amplifying direct current changes, said amplifier circuit being fed by said input circuit and having an indicator in the last stage thereof, an automatic voltage adjusting circuit comprising a time delay control tube circuit, first means for converting the output of said time delay control tube circuit from direct to alternating current, second means for isolating the output of the time delay control circuit from the supply voltage for said amplifier circuit, third means for rectifying the resultant isolated voltage and applying the rectified resultant to the input of said amplifier circuit, said automatic voltage adjusting circuit being thereby arranged to act as a time-delayed, inverse, direct current feedback circuit operating to maintain the indicator in the amplifier circuit at a predetermined rest point regardless of slow changes in the resistance between the said two points while permitting the more rapid changes in the resistance between the two points to pass through said amplifier circuit and operate said indicator.

3. A device for detecting small rapid changes in electrical resistance between two points on a body, regardless of the existing resistance level before the change took place, said device being automatic in its operation and designed primarily for use in detecting the psychogalvanic response without the necessity of making manual adjustments during the test period, said device comprising (a) a direct coupled amplifier circuit, (b) a time delayed control tube circuit operating in parallel with the last stage of the direct coupled amplifier circuit, (c) a grid controlled rectifier circuit in which direct current pulsations are controlled by the action of the above mentioned time delayed circuit, (d) a transformer which converts the pulsating direct current flowing in the grid-controlled rectifier circuit into alternating current, this alternating current being electrically isolated from the voltage supply for the amplifier tubes, and (e) a rectifier circuit which rectifies the alternating voltage appearing at the secondary of the isolating transformer, the alternating current component of this voltage being subsequently filtered out and the remaining direct current voltage applied to the input circuit of the amplifier.

4. A device in accordance with claim 3 wherein means are provided for detecting the psychogalvanic response through visual observation of an indicating meter.

5. A device in accordance with claim 3 wherein means are provided for adjusting the rest point of said indicating meter.

6. A device for detecting small rapid decreases in the electrical resistance between two points, on a body regardless of the resistance level existing between these points before the change took place, said device being designed primarily for use as a psychogalvanometer, and operating in such a manner as to automatically compensate for slow variations in the ohmic value of resistance connected to the input terminals of electrodes, thus eliminating the necessity for making manual adjustments to maintain the indicating meter at some predetermined rest point, said device comprising (1) an input circuit consisting of a pair of electrodes to contact said points, and a fixed resistance delivering the output of an automatic voltage adjusting circuit, (2) an element consisting of a direct coupled amplifier circuit; (3) an element consisting of a time-delayed control tube stage operating in parallel with the last stage of the direct coupled amplifier, (4) an element consisting of a grid-controlled rectifier circuit in which the amplitude of current pulses is controlled by the direct current output of the above mentioned time-delayed circuit, (5) an element consisting of an isolating transformer in series with the grid-controlled rectifier circuit, (6) an element consisting of a rectifier and filter circuit which converts the alternating current output of the isolating transformer into direct current applied to the input circuit element (1).

7. A device in accordance with claim 6, wherein elements (3) through (6) comprise an automatic voltage adjusting circuit or a time-delayed, inverse, direct-current feedback circuit operating in such a manner as to maintain the indicating meter in the last amplifier stage at a predetermined rest point regardless of slow changes in the subject's effective resistance, but at the same time permitting the more rapid changes caused by the psychogalvanic response to pass through the amplifier and be indicated by the meter.

8. A device in accordance with claim 6 wherein means are provided for detecting small sudden departures from any resistance level through visual observation of an indicating meter or recorder.

9. A device in accordance with claim 6 wherein means are provided for adjusting the rest-point of the indicating meter.

10. A device in accordance with claim 6 wherein means are provided for adjusting the sensitivity of the instrument.

11. A device in accordance with claim 3 wherein means are provided for controlling the sensitivity of the apparatus.

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**Jan. 19, 1943.**

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**2,308,933**

PSYCHO-GALVANOMETER

Filed Jan. 8, 1941

2 Sheets-Sheet 1

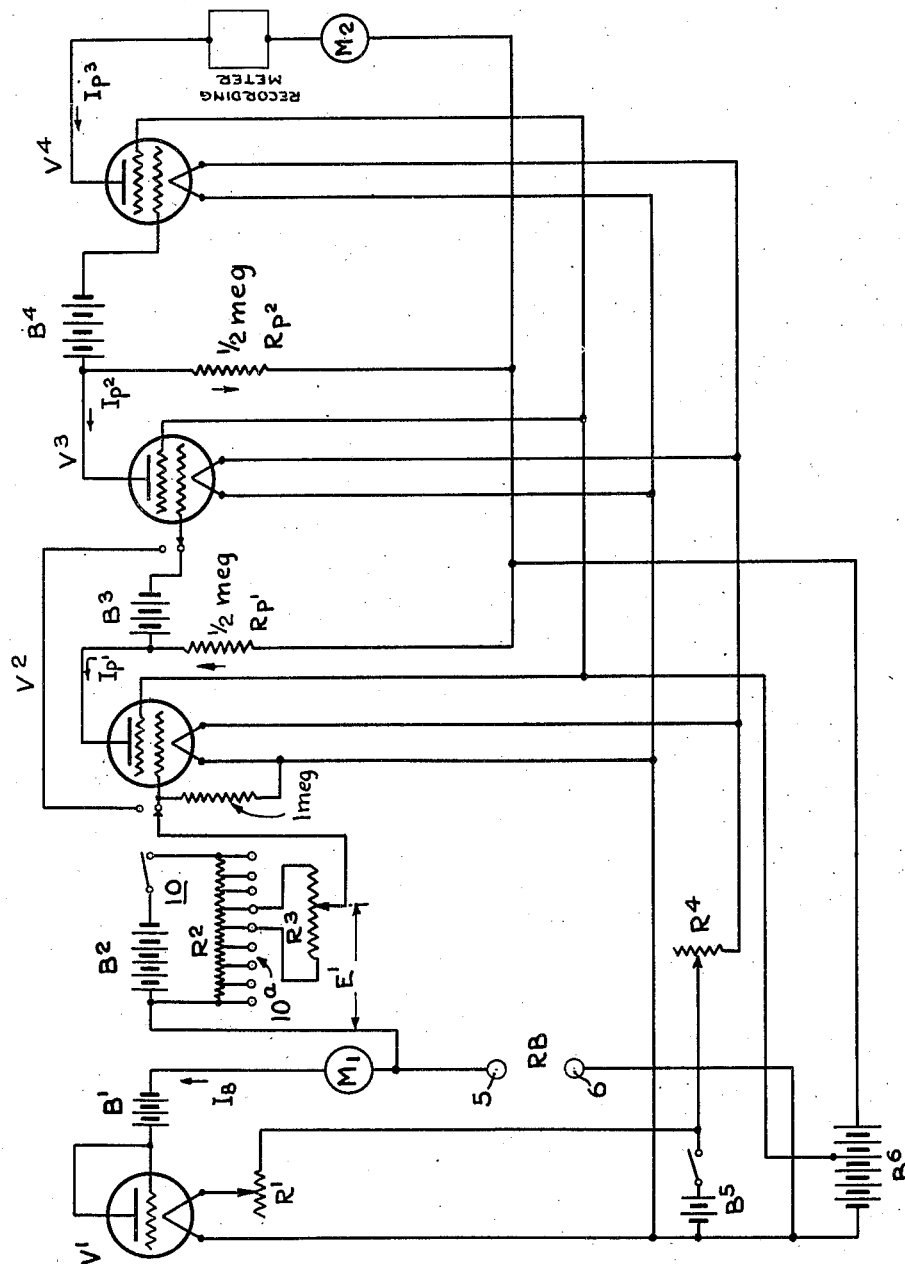


Fig. 1.

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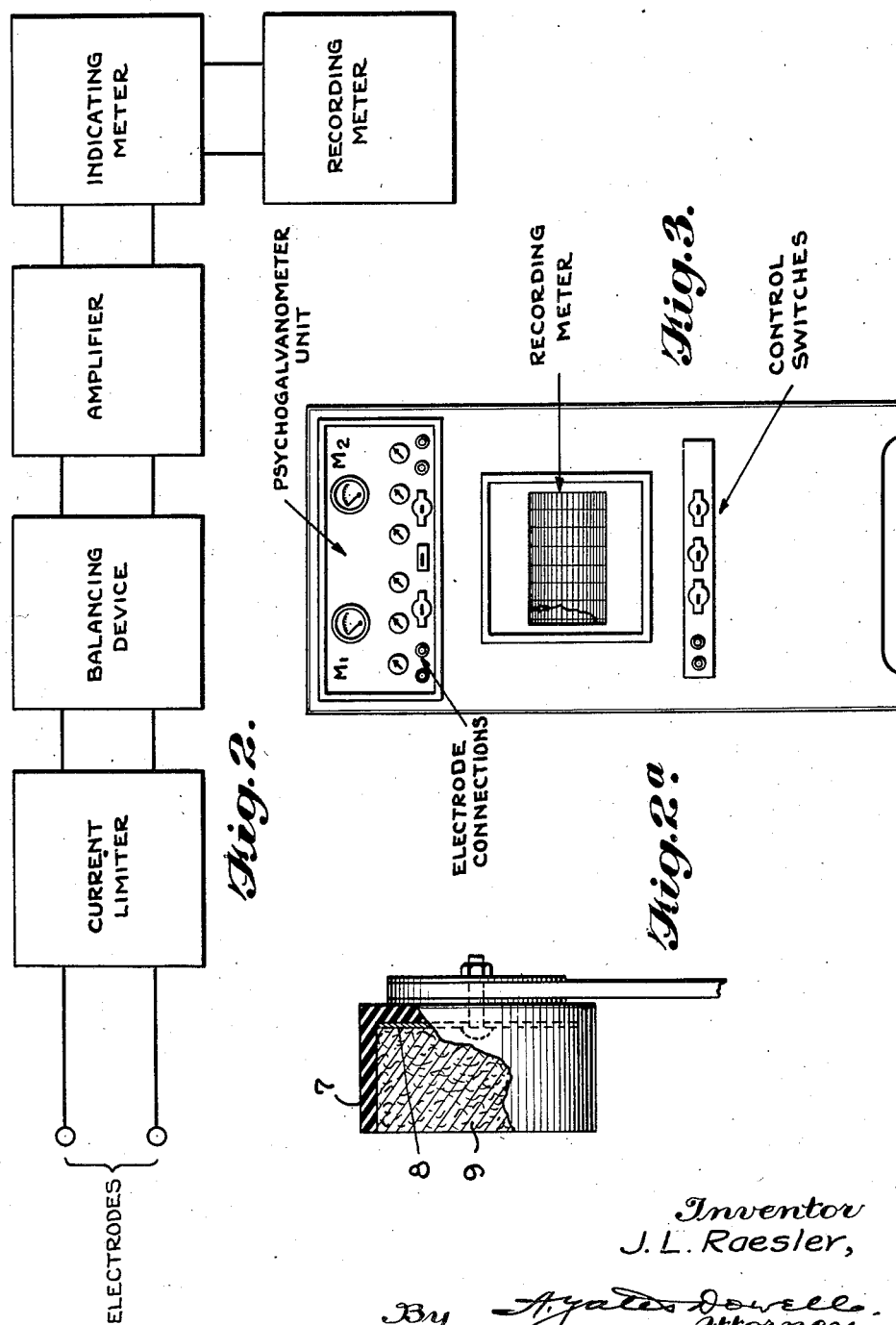
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PSYCHO-GALVANOMETER

Filed Jan. 8, 1941

2 Sheets-Sheet 2



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## UNITED STATES PATENT OFFICE

2,308,933

## PSYCHOGALVANOMETER

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Application January 8, 1941, Serial No. 373,670

4 Claims. (Cl. 128—2.1)

This invention relates to a method of and apparatus for measuring psychogalvanic responses.

Psycho-galvanometers have long been known and used with varying degrees of success. Constant improvement has materially increased their sensitivity but they still cannot be definitely relied upon to give an accurate indication of the factors which it is desired to study. Changes in circuit and application of electrical equipment which might have little effect on other types of measuring instruments may materially affect the operation of a psycho-galvanometer.

The primary object of the present invention is to improve the efficiency of psycho-galvanometers. More particularly, the invention aims to increase the sensitivity and factor selectivity of psycho-galvanometers and at the same time simplify their construction and operation.

Generally stated, the method consists in initiating a controlled flow of direct current through the body under test and maintaining the current constant while measuring variations in potential due to changes in body resistance resulting from emotional or physical stresses.

The various features of novelty and advantages inherent in the improved psycho-galvanometer will become apparent in view of the following description taken in conjunction with the drawings, wherein:

Fig. 1 is a diagram of the electric circuit for the improved psycho-galvanometer of the present invention;

Fig. 2 is a schematic diagram of the units which make up the apparatus;

Fig. 2a is a detail view in sectional elevation of a preferred form of electrode;

Fig. 3 is a view in front elevation of the apparatus housed in a cabinet.

Referring to the drawings in detail, a pair of electrodes are indicated at 5 and 6, each of which preferably comprises a cup 7 of insulating material such as Bakelite having a conductor in the form of a plate 8 of aluminum or the like in the base thereof, note Fig. 2a. The cup 7 is adapted to receive absorbent material such as a small sponge 9 saturated with a fluid of high conductive properties, for example, a five per cent solution of sodium hypochlorite. This type of electrode ensures an effective contact in that any irregularities in the part to which the electrode may be connected, such as the palm of the hand, are compensated for, such irregularities being filled with liquid and the area of contact re-

maining constant as well as the contact resistance after the liquid has permeated the skin.

Referring particularly to Fig. 1, RB indicates body resistance. Tube V1 is connected as a diode to limit the amount of current passed through the body. Electron flow through tube V1 is controlled by rheostat R1 which adjusts the filament temperature. Plate and grid voltage to this tube is supplied by battery B1, and if there is any tendency of the battery voltage to decrease during a test due to polarization, it is overcome by the limiting action of the diode.

A balancing unit is provided and comprises potentiometer 10 having contacts 10a and resistances R2 and R3. Electrode 5 connects to the input to the amplifying unit through R2 and R3.

The amplifier unit is of the direct current type and as here shown embodies three stages made up of tubes V2, V3 and V4. Plate voltage is supplied by batteries B3 and B4 and grid voltage by battery B6. Rheostats or resistances Rp1 and Rp2 are used as plate circuit load resistors. Filament voltage is supplied by battery B5 and is controlled by rheostats R4 and R1.

Indicating meter M1 is inserted in the test circuit to indicate the body current, and another meter M2 is inserted in the amplifying circuit.

The body resistance RB varies during the test, and accordingly there is a variation in the voltage drop across this resistance. Before beginning a test, the potentiometer 10 is adjusted by means of R2 and R3 so that the voltage drop across RB equals E1. In other words, the voltage at E1 should be exactly equal to and of opposite polarity to the voltage drop across RB. When this happens, the voltage applied to the grid of V2 is nil. The voltage drop across Rp1 equals  $I_{p1} \times R_{p1}$  and this is reduced by battery B3, so that the grid voltage of V3 is proper for normal operation as a class A amplifier. This same procedure is followed in the remaining stages until the final plate current  $I_{p3}$  flows through the indicating meter M2.

In normal operation, the subject or person under test has the electrodes 5 and 6 connected to the palm of the hand or other suitable part of the body. Filament of tube V1 is then adjusted by means of R1 until meter M1 shows 0.25 milli-ampere body current. R2 and R3 are now adjusted until meter M2 shows full scale reading or slightly less. A preliminary test will indicate if the sensitivity is great enough for the person being tested. If not, the body current may be increased to 0.50 or 0.75 ma. As the test develops, any increase in emotional activity in the subject

will cause a decrease in body resistance (RB) which is proportional to such emotional activity. In the ordinary application of a non-saturated electrode to the surface of the skin of the subject for purposes of emotional stress measurements, the change in conductivity of the skin surface is caused largely by increased activity of the sweat glands and results in a decrease rather than an increase in the conductivity of the skin surface because of the more intimate connection presented to the electrode by the change in moisture content between the electrode and the skin pres. However, I use an electrode saturated with an ionizable and highly conductive saline solution which is limited to a fixed area of the skin surface so that the resistance due to changes in area of contact are negligible. Also, the changes in conductivity by a change in the amount of perspiration on the skin are a negligible quantity since the surface is already saturated and covered intimately with the conducting solution. The only chance for a change here would be caused by inability of the electrode solution to permeate the skin's surface. However, by leaving the electrodes attached for a short period before conducting the test, the skin penetration of the electrolyte in the electrode becomes quite complete.

Now, since the contact resistance is made practically constant, the only changes that are able to cause a change in body resistance are those changes that occur in the cells of the body. These cells undergo a certain chemical change due to energy released by emotional stresses in the body which acts to reduce the body resistance. This is apparently caused by an increased rate of decomposition or ionization in each cell. There seems no more direct proof that this is so other than the substitution of a known resistance which will simulate changes in body resistance under stress. When the substituted resistance is decreased in value, remembering that the contact resistance is constant because of the action of the saturated electrode, the meter deflection is identical to that observed when increased emotional stress is evinced by the test subject. This decrease will cause a decrease in the voltage across the body (RB) so that  $E1 - RB = 0$  and the voltage ( $E1 - Ib RB$ ) will be impressed on the grid of V2, which will increase the plate current  $Ip1$ . Voltage  $Ip1 \times Rpf$  will increase and the negative voltage will be correspondingly increased to the grid of V3 which will decrease the current  $Ip2$ . This change will be directly proportional to the change occurring in body resistance but will be much greater due to amplification. While three stages of amplification are illustrated, two will ordinarily be sufficient. The amplifier should be a direct coupled unit due to the extremely low frequency of the changes in resistance which occur during test.

In Fig. 1 a recording meter is shown for indicating the variations in plate current of tube V4 resulting from changes in body resistance across terminals 5 and 6. This meter may be used to obtain a permanent record of a subject's reactions for future reference. The meter may have a scale range of 0 to 5 milliamperes, which is the approximate value for the circuit here shown.

From the foregoing, it will be seen that the device measures a potential across the body which is caused by direct current flow through the body from an external source, such changes in potential arising due to changes in resistance of the body and not due just to the current flow

through the body. The use of direct current is important, since alternating current sets up capacity effects between the body and ground which cause a change in readings not attributable to the changes which it is desired to study or measure. Tube V1, connected as a diode, provides a very convenient method of adjusting the current flow through the body, using a thoriated filament tube.

Fig. 3 illustrates the unit mounted in a cabinet with the various controls accessible at the front of the cabinet. Parts which correspond to those shown diagrammatically in Fig. 1 are given like reference characters in Fig. 3.

Actual experience has demonstrated that the device is highly sensitive and is unusually accurate in measuring or indicating emotional stresses which occur in the human body.

It will be understood that certain changes in construction and design as well as arrangement of the electrical circuit may be adopted within the scope of the invention as defined by the appended claims.

What is claimed is:

1. In apparatus for measuring psychogalvanic responses in a human body, an electrical circuit including electrodes adapted to be connected to the body, said electrodes carrying a substance having a high coefficient of electrical conductivity capable of permeating the surface of the skin of the body, means for causing a flow of direct current in said circuit and through the body, a vacuum tube having an anode and cathode connected in said circuit as a diode to maintain a predetermined flow of current through the body, a potentiometer connected into said circuit to balance the latter preliminary to a test, a direct current amplifier arranged to amplify the variations in potential due to changes in body resistance, and a meter for indicating or recording such changes.

2. In apparatus for measuring psychogalvanic responses in a human body, an electrical circuit including electrodes adapted to be connected to the body, said electrodes carrying a substance having a high coefficient of electrical conductivity capable of permeating the surface of the skin of the body, means for establishing a flow of direct current in said circuit and through the body, a vacuum tube having an anode and cathode connected as a diode in said circuit to maintain constant the flow of current through the body, means for adjusting the filament voltage of said tube to in turn adjust the current flow through the body, a meter for visibly indicating body current, a potentiometer connected into said circuit and adjustable to balance the latter preliminary to a test, a multi stage direct current amplification unit including vacuum tubes whose input circuit is connected to said potentiometer and whereby any changes in body resistance are impressed on the grid of the amplifying circuit, and a meter for indicating such amplified changes.

3. In apparatus for measuring psychogalvanic responses in a human body, an electrical circuit including electrodes adapted to be connected to spaced points of the body, said electrodes carrying a substance having a high coefficient of electrical conductivity capable of permeating the surface of the skin of the body, means for establishing a flow of direct current in said circuit and through the body, a vacuum tube having a cathode and anode connected in said circuit as a diode to maintain constant the flow of current through the body, a rheostat for adjusting the

filament of said tube to in turn adjust the current flow through the body, a meter for visibly indicating body current, an amplifying circuit indicating body current, an amplifying circuit including a plural stage direct current amplifying unit having vacuum tubes and a grid circuit, a potentiometer having one terminal connected to said first named circuit and another terminal connected to the grid circuit for balancing the circuit preliminary to a test, and a meter connected into the final stage of the amplifying circuit for indicating amplified changes in body resistance.

4. The method of measuring psycho-galvanic responses in a human body, which consists in applying to a limited area of the skin of a patient a pair of electrodes carrying a fluid having a high coefficient of electrical conductivity which permeates the surface of the skin, maintaining the contact resistance substantially constant while initiating a constant flow of direct current through the body, and measuring the variations in potential across the body resulting from changes in resistance of the body.

JOHN LEO RAESLER.

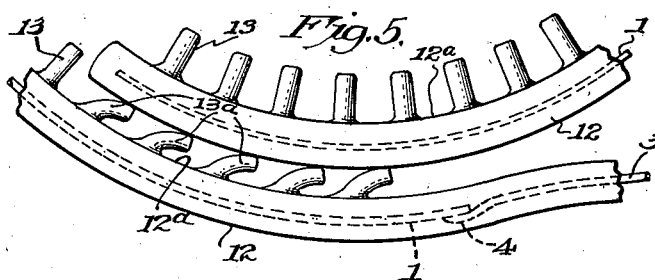
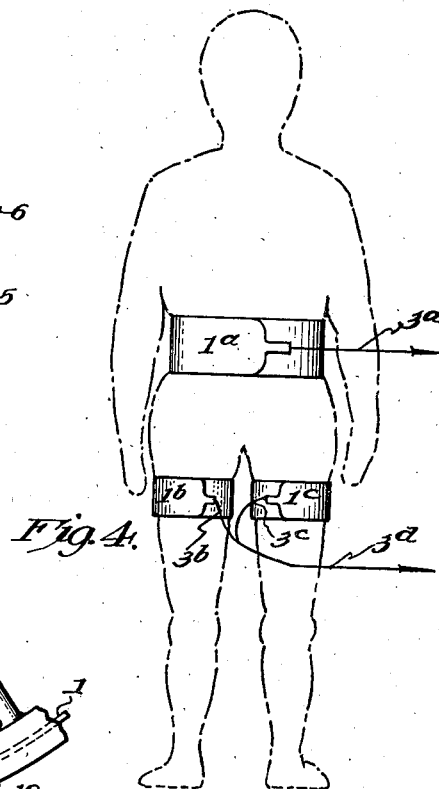
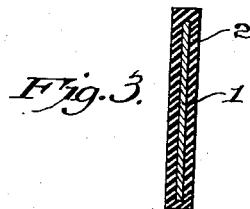
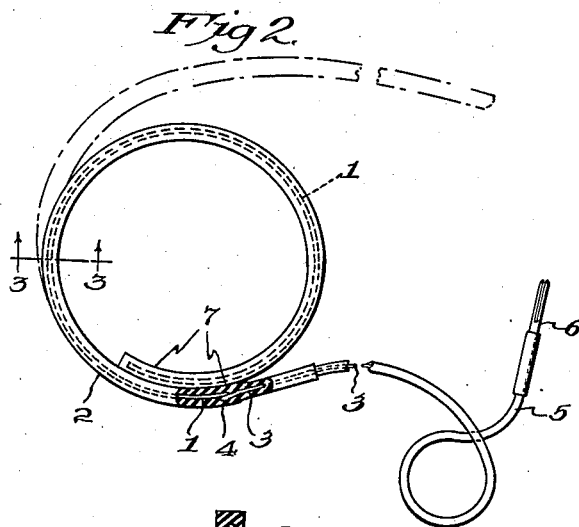
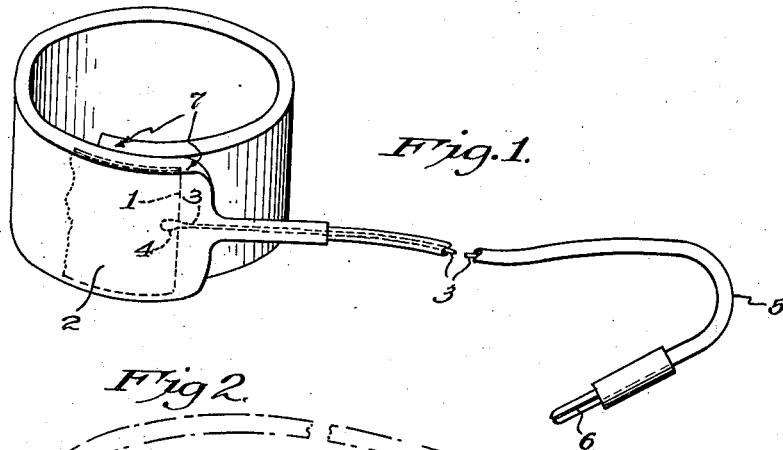
March 8, 1938.

E. L. DORR

2,110,392

SELF SUPPORTING ELECTROTHERAPY ELECTRODE

Filed Jan. 6, 1937.



INVENTOR.  
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## UNITED STATES PATENT OFFICE

2,110,392

SELF-SUPPORTING ELECTROTHERAPY  
ELECTRODEEdwin L. Dorr, Clayton, Mo., assignor to Edgar J.  
Rose, Los Angeles, Calif.

Application January 6, 1937, Serial No. 119,224

3 Claims. (Cl. 128—413)

This invention pertains to electrode devices for application of diathermy or other electric currents to the human body, and pertains particularly to a self-supporting electrode device adapted for attachment to a body member or body portion.

Flat pad electrodes and elongated electrodes of the form of a strap have been used for the application of therapeutic diathermy currents, either in contact with the patient or spaced therefrom, for the application of electrotherapy currents to the torso or to the body extremities such as the arms or legs. These electrodes have not proved satisfactory for such purposes, due to the difficulty encountered in retaining them in position on the patient's body throughout treatment. Various forms of straps and harnesses have been devised for holding such electrodes in position on the patient's body; however, such devices have not proved satisfactory, due to the time required for positioning and the inconvenience brought about by such operations.

The principal object of the invention is to provide a flexible, resilient electrode which may be conveniently positioned about an extremity or torso of the patient and which will retain such position for extended periods without the use of straps or harnesses of any kind.

One of the particular objects of the invention is to provide an electrode member adapted to surround a body member in resilient engagement therewith. A further object of the invention is to provide a resiliently deformable electrode member which is normally coiled into a generally circular form of such size as to fit about a body member in resilient engagement therewith, and deformable so as to be readily distorted into an extended shape by manual means for removal from the body member.

Another object of the invention is to provide an electrode means for therapeutic purposes having an elongated, electrically conductive spring member which is normally coiled into a substantially circular configuration and normally having overlapping ends, which is adapted to be grasped at said ends and pulled to an open position for insertion of a body member and which will upon release of said ends tend to resume its original configuration and embrace said body member.

Another object of the invention is to provide a flexible, resilient, insulated electrode means in which the conductive element provides the major portion of the resiliency of the device as a whole.

Other objects of the invention will either be

specifically set forth in the following description or will be apparent therefrom.

The device of this invention may comprise an electrically conductive, flexible, resilient member normally conforming to a substantially circular or cylindrical configuration and adapted to be resiliently deformed outwardly into the shape of C for the reception of a body member and operable, upon the release of the deforming force, to return towards its normal or substantially cylindrical position and resiliently embrace said body member. Means are also provided for connecting the resilient conducting member to a source of electrical current.

I have illustrated a preferred embodiment of my invention in the accompanying drawing and referring thereto:

Fig. 1 is a perspective view of the device in the normal or closed position showing the enclosing insulating envelope in full lines and a portion of the resilient electrode in dotted lines;

Fig. 2 is a partly broken-away plan view of the device corresponding to Fig. 1, showing the body-receiving or outwardly extended position thereof in dot-dash lines;

Fig. 3 is a sectional view thereof taken on line 3—3 in Fig. 2;

Fig. 4 is an outline of a human body with a plurality of electrodes according to this invention disposed in position for diathermy treatment; and

Fig. 5 is an enlarged view corresponding to the lower portion of Fig. 2, showing a broken-away plan view of a device of the present invention provided with a modified form of insulating envelope.

Referring to the drawing, the device is shown as comprising a resilient conducting member 1, such as a ribbon-like spring of extended area, encased in a suitable flexible insulating envelope 2 which may be formed of soft rubber or the like, said spring being normally coiled into a substantially circular shape so as to form a substantially cylindrical structure having an appreciable length in the direction of its axis. An electrical connector 3 is shown connected to the outer end of the member 1 as at 4 in any suitable manner, as by soldering, brazing, riveting or the like. The connector 3 is suitably encased in an insulating envelope 5 of rubber or the like and terminates in a contact member 6 which may be used to provide electrical connection to a source of high frequency or other electrical energy, according to common practice. When the device is in "rest" position, as shown in Figs. 1 and 2 in full lines, the ends thereof preferably overlap as at

7, and the device is adapted to be grasped manually at its two ends and opened into the extended shape shown in dot-dash lines in Fig. 2, in which the ends of the device are brought out of their overlapping relation and are separated from one another, so as to be readily slipped over a body member in use.

It will be appreciated that where direct contact of the electrode with the body member is desired, the envelope 2 may be cut away at its inner face to form a structure equivalent to the type of contact electrode member provided in U. S. Patent No. 1,975,518 to E. J. Rose.

The electrode of the present invention may be employed in sets of two or more, the respective electrodes being connected to opposite sides of the means for supplying a diathermy, radiotherapy or other treatment current, said electrodes being disposed at opposite sides of the body portion to be subjected to treatment, as above and below the knee joint, or, in some cases, a relatively large electrode may be placed about the trunk of a person as shown at 1a in Fig. 4 and connected to one side of the source of energy through a connector 3a, and two or more smaller electrodes 1b and 1c placed on the respective thighs, whereby the pelvic region may be treated. In such a case, the two smaller electrodes 1b and 1c would be connected together as through connectors 3b and 3c and electrically associated with the side of the source of energy opposite the side to which the electrode 1a is connected through a connector 3d.

According to the preferred embodiment of the device, the resilient electrode 1 is relied upon substantially entirely to provide the desired resilient engagement of the body member, and the insulating envelope 2 is not required to be resilient to any degree. The device of the present invention eliminates the use of binding devices such as straps or the like, and makes possible the facile application of the electrode to substantially any body member, the inherent resilience of the electrode member serving to maintain the same in position.

The embodiment illustrated in Fig. 5 comprises an electrode 1 provided with an insulated envelope 12 of rubber or the like, the inner surface 12a of which is provided with a plurality of inwardly projecting protuberances or bosses 13 adapted to serve the double purpose of spacing the electrode from the body portion under treatment and more effectively positioning the degree of overlap of the end portions of the device. The inwardly directed protuberances 13 are preferably formed of flexible resilient material such as rubber, and may be formed integrally with the envelope 12. In the showing in Fig. 5, the end portions may be considered to overlap slightly more than in the normal rest position of the

device, so as to accommodate the device to a relatively small body member such as the calf (in comparison with the showing in Fig. 2 which may be considered to represent the overlap employed when the device is encircling the lower thigh), in which case the device will tend to open upon itself to some extent and this movement will be opposed by the resilient protuberances or bosses 13a on the overlapping portion of the device which are in engagement with the underlapping portion of the device. The bosses 13 are preferably of such length as to provide a spacing of approximately three-eighths inch between the electrode envelope and the surface of the body portion under treatment, and may be uniformly spaced over the inner surface of the envelope on three-eighths or one-half inch centers, as an example.

Other modifications of the device will occur to those skilled in the art and I do not choose to be limited to the specific embodiments herein delineated but rather to the scope of the appended claims. It will be appreciated that the expression "substantially circular" or "substantially cylindrical" is intended to include such shapes as are generally circular in configuration, i. e., oval, or the like, inasmuch as the symmetry of a true circle is not of importance to the present invention.

#### I claim:

1. A self-supporting electrotherapy electrode adapted for attachment to a portion of a human body, which comprises: an elongated flexible electrical conductor formed of a resilient metal and coiled into substantially circular configuration to form a substantially cylindrical structure in which the ends of said conductor normally overlap one another, and conductor means secured to one end of said flexible conductor to provide electrical connection to a source of treatment current, said flexible conductor being adapted to be grasped manually at said ends and pulled to an extended shape in which said ends are in separated position and being operable upon release of said ends to resume its original configuration, whereby a body portion may be inserted between the separated ends of said flexible conductor when said flexible conductor is in said extended position and embraced by said flexible conductor upon release of said ends.

2. The construction set forth in claim 1, and comprising in addition, a flexible insulating envelope enclosing said flexible conductor.

3. The construction set forth in claim 1, and comprising in addition, a flexible insulating envelope enclosing said flexible conductor, said envelope being provided with a plurality of inwardly projecting protuberances over the major portion of the inwardly directed surface thereof.

EDWIN L. DORR. 60



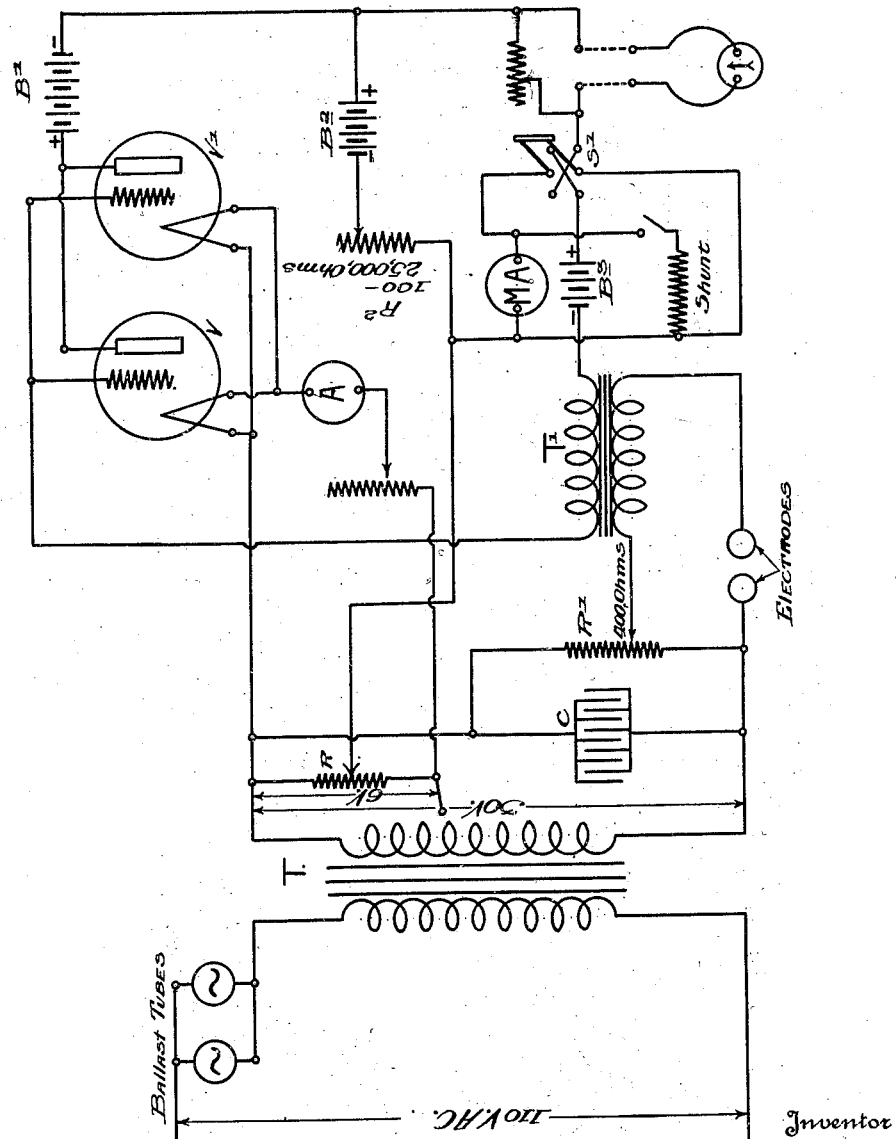
**June 3, 1930.**

**S. R. HATHAWAY**

**1,761,476**

# APPARATUS FOR MEASURING PSYCHOGALVANIC RESPONSES

Filed Jan. 20, 1928



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## UNITED STATES PATENT OFFICE

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## APPARATUS FOR MEASURING PSYCHO GALVANIC RESPONSES

Application filed January 20, 1928. Serial No. 248,202.

This invention relates to an apparatus for measurement of the psychogalvanic response in human beings and animals.

It is a well recognized phenomenon that certain mental states in humans and animals are closely allied to emotions and that in response to such mental states or emotions there is a change or variation in the electrical conductivity of the skin of the body. This phenomenon is designated the psychogalvanic response, or the psychogalvanic reflex, galvanic response or tachographic response.

An object of the invention is to provide a simplified method of and apparatus for measuring the psychogalvanic response set up in the human or animal body when it is subjected to such processes as the sudden realization of success or failure in working problems, psychological tests, etc. The apparatus gives a measurable reading of the amount of galvanic reflex response in magnitude and frequency in various individuals, which information is invaluable in classifying groups of human beings as to their reactions and emotions.

The accompanying drawing is diagrammatic of the circuit of the apparatus utilized for carrying out the above object. This apparatus is, of course, subject to modification and rearrangement without departing from the spirit of the invention. It will be noted that the usual 110 volt alternating current house line is utilized, as this is most practical, although, of course, direct current from batteries might be employed.

Current supply from the 110 volt line is fed to the primary transformer T, from the secondary side of which is tapped the 6 volt filament current for lighting the three element thermionic tubes V and V<sub>1</sub>. This transformer is also tapped so that an output current of 30 volts is available for the electrode potential. It will be noted that a plurality of ballast tubes are placed in the primary transformer circuit and a fixed condenser in the secondary circuit. These devices, while not essential to the operation of the apparatus, tend to minimize the variations of line voltage which might intrude

to a degree affecting the sensitiveness of the apparatus.

A low frequency transformer T is used for applying the grid voltage for the vacuum tubes. Two vacuum tubes are used in parallel in this instance since current amplification is desired. The tubes perform the double function of rectification of the alternating current and amplification of the changes in the amount of current flowing in the circuit. This also permits a preliminary stepping up of the potential. By proper selection of this transformer the secondary output will not vary enough to cause a loss of sensitivity due to overcharging of the grids. Negative grid potential is applied by a battery B<sub>2</sub> at 22½ volts and this potential is kept constant for most uses. Since it is desirable to have approximately the same initial electrode current for each individual subject tested, the voltage is set to a value which is dependent on the characteristic curve of the vacuum tubes used.

The plate voltage for the vacuum tubes is supplied by the batteries B<sub>1</sub> which carry 90 volts. As it is necessary to neutralize the constant plate voltage if small incremental changes are to be read on the milliammeter, battery B<sub>3</sub> is connected so as to send a current through the meter in the direction opposite from that normally flowing in the plate circuit, this counter-current being controlled by a shunt.

Advantage is taken of the fact that the grid current varies substantially directly with the grid voltage. To utilize this, a double pole double throw switch S<sub>1</sub> is placed in the circuit so as to change the plate milliammeter from the plate circuit to the grid circuit for preliminary adjustment of the electrode potential, the strength of the grid current for maximum sensitivity being approximately .01 milliampere. In practice the electrodes used are of nickel and about 2.2 cm. in diameter.

From the above description of the apparatus it will be seen that when a human or animal subject has the electrodes in contact with the skin of the body, as the palms of the hands or paws, and the body is subjected

to emotional stresses, as success or failure in solving problems, etc., there will be a change in the conductivity of the subject's skin which increases the resistance in the electrical circuit of the apparatus. This change  
5 in conductivity varies the electrical circuit to an extent which effects the electronic flow through the vacuum tubes and is recorded on a sensitive milliammeter or galvanometer. This meter reading gives the  
10 amount of change which is translated by those skilled in the art to give a basis for analyzing the psychogalvanic response in the subject.

15 It will be noted that the amount of current flowing between the electrodes may be varied by  $R_1$  so that the grid potential may be kept at nearly the same value regardless of the difference in skin resistance and conductivity of various patients or subjects, the  
20 electrode being generally adjusted by the potentiometer until a reading of .01 milliampere is obtained on the milliammeter in the grid circuit.

25 For the purpose of taking photographic records and for student class demonstrations where it is desired to throw a spot of light on a screen so that the class may observe the reactions, a shunt control and an external reflecting galvanometer are provided.  
30 This is clearly shown in the diagrammatical circuit.

Claim:

35 An apparatus for electrically measuring psychogalvanic responses in human beings when subjected to emotional strain, which consists of an electrical alternating current circuit, electrodes in said circuit adapted to  
40 be placed in contact with the human being's skin, a thermionic amplification device including a grid potential, means for adjusting the grid potential and means for indicating on an electrical measuring instrument the variations of resistance of the electrodes.  
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